

USAF SERIES **F-105D, F-105F & F-105G** AIRCRAFT

Flight Manual

FAIRCHILD HILLER
REPUBLIC AVIATION DIVISIONPublished Under Authority of the
Secretary of the Air Force

Commanders are responsible for bringing this manual to the attention of all Air Force personnel cleared for operation of subject aircraft.

This publication replaces T.O. 1F-105D-1S-236, 1F-105D-1S-117, 1F-105D-1S-171, 1F-105D-1S-183, 1F-105D-1S-185, 1F-105D-1S-187, 1F-105D-1S-190, 1F-105D-1S-193, 1F-105D-1S-194, 1F-105D-1S-197, 1F-105D-1S-198, and 1F-105D-1S-203. 1F-105D-1S-169 was replaced in Change No. 1 dated 12 December 1969.

See T.O. 0-1-1-4 for current status of Safety Supplements and Operational Supplements.

BASIC AND ALL CHANGES HAVE BEEN MERGED TO MAKE THIS A COMPLETE PUBLICATION.

CHANGE

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Dates of issue for original and changed pages are:

Original . . . 0 . . . 30 Jun 69 Change . . . 2 . . . 26 Mar 70
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TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 856 CONSISTING OF THE FOLLOWING:

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*1-50	3			1-210B Blank Added	1

CURRENT FLIGHT CREW CHECKLIST

T.O. 1F-105D-1CL-1 30 June 1969 Changed 1 October 1970

Upon receipt of the second and subsequent changes to this technical order, personnel responsible for maintaining this publication in current status will ascertain that all previous changes have been received and incorporated. Action should be taken promptly if the publication is incomplete.

* The asterisk indicates pages changed, added, or deleted by the current change.

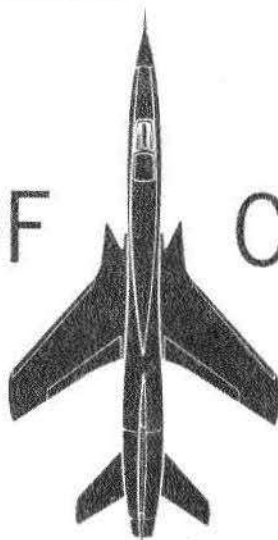
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THIS INFORMATION IS IMPORTANT!

Read Page i

SCOPE.

This manual contains the necessary information for safe and efficient operation of the F-105D, F-105F and F-105G. These instructions provide you with a general knowledge of the aircraft, its characteristics, and specific normal, and emergency, operating procedures. Your flying experience is recognized, and therefore, basic flight principles are avoided.

SOUND JUDGMENT.

This manual provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc. may require modification of the procedures.

PERMISSIBLE OPERATIONS.

The Flight Manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein. Clearance must be obtained from the Flight Manual Manager before any questionable operation is attempted which is not specifically permitted in this manual.

HOW TO BE ASSURED OF HAVING LATEST DATA.

Refer to T.O. 0-1-1-4 and Status pages accompanying each Safety and Operational Supplement. The current status of all Flight Manuals, Supplemental Flight Manuals, Safety Supplements, Operational Supplements, and Checklists is listed on the Status pages. Their frequency of issue and brevity assures accurate, up-to-date listing of these publications.

STANDARDIZATION AND ARRANGEMENT.

Standardization assures that the scope and arrangement of all Flight Manuals are identical. The manual is divided into seven fairly independent sections to simplify reading it straight through or using it as a reference manual.

OPERATIONAL SUPPLEMENTS.

Operational supplements are issued as an expeditious means of reflecting information when mission essential operational deficiencies are involved.

SAFETY SUPPLEMENTS.

Information involving safety will be promptly forwarded to you by Safety Supplements. Supplements covering loss of life will get to you in 48

hours by TWX, and those concerning serious damage to equipment within 10 days, by mail. The title page of the Flight Manual and the title block of each Safety Supplement should also be checked to determine the effect they may have on existing supplements. You must remain constantly aware of the status of all supplements — current supplements must be complied with but there is no point in restricting your operation by complying with a replaced or rescinded supplement.

CHECKLISTS.

The Flight Manual contains only amplified checklists. Abbreviated checklists have been issued as separate technical orders — see the back of the title page for T.O. number of your latest checklist. Line items in the Flight Manual and checklists are identical with respect to arrangement and item number. Whenever a Safety Supplement affects the Abbreviated checklist, write in the applicable change on the affected checklist page. As soon as possible, a new checklist page, incorporating the supplement will be issued. This will keep handwritten entries of Safety Supplement information in your checklist to a minimum.

HOW TO GET PERSONAL COPIES.

Each flight crew member is entitled to personal copies of the Flight Manual, Safety Supplements, Operational Supplements, and Checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your supply personnel — it is their job to fulfill your Technical Order requests. Basically, you must order the required quantities on the Publication Requirements Table (T.O. 0-3-1). Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

FLIGHT MANUAL AND CHECKLIST BINDERS.

Loose leaf binders and sectionalized tabs are available for use with your manual. These are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Binders are also available for carrying your abbreviated checklist. These binders contain plastic envelopes into which individual checklist pages are inserted. They are available in three capacities and are obtained through normal Air Force supply under the following stock list

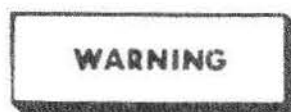
numbers: 7510-766-4268, -4269, and -4270 for 15, 25, and 40 envelope binders respectively. Check with your supply personnel for assistance in securing these items.

DEFINITION OF WORDS, "SHALL," "WILL," "SHOULD," AND "MAY."

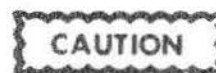
The words "shall" and "will" indicate a mandatory requirement. The word "should" indicates a non-mandatory desire or preferred method of accomplishment. The word "may" indicates an acceptable or suggested means of accomplishment.

WARNINGS, CAUTIONS, AND NOTES.

The following definitions apply to "Warnings," "Cautions," and "Notes" found throughout the manual.



Operating procedures, techniques, etc., which will result in personal injury or loss of life if not carefully followed.



Operating procedures, techniques, etc., which will result in damage to equipment if not carefully followed.

Note

An operating procedure, technique, etc., which it is considered essential to emphasize.

YOUR RESPONSIBILITY — TO LET US KNOW.

Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. AF Form 847 will be used for recommending changes to the Flight Manual in accordance with instructions in AFR 60-9 and T.O. 00-5-1. These will be forwarded through Command Headquarters to SMAMA, McClellan AFB, California, ATTN: MMSTA. AF Forms 847 are routed to SMNSTA for control purposes only. Technical content of the Flight Manual is the responsibility of the Flight Manual Manager (SMNEAH) and all comments and questions transmitted by means other than the AF Form 847 will be submitted directly to the Flight Manual Manager, SMAMA, McClellan AFB, California, ATTN: MMEAH.

TCTO IDENTIFICATION

The following Technical Orders affect operating procedures. OPERATING PERSONNEL MUST BE AWARE OF THEIR STATUS. Technical Orders which have no affect on operations or which are obvious to the pilot are not included.

System or Procedure	Technical Order	Description	TCTO to be complied with on the following aircraft:
ALL	1F-105-1133	Modification and Redesignation of F-105 F Aircraft to F-105G Configuration	* ☐ F * ☐ G
COMM	1F-105-1036	Secure Voice Capability, F-105D/F Aircraft	☐ D all * ☐ F * ☐ G
COMM	1F-105-1079	Install QRC-373 ECM Capability F-105D/F Aircraft	☐ D all * ☐ F * ☐ G
COMM	1F-105-1143	Removal of the SST-181 X Switching Assembly, F-105D/F/G Aircraft	☐ D all * ☐ F * ☐ G
COMM	1F-105D-680	Install Increased (RHAW) Capability F-105D Aircraft	☐ D all
COMM	1F-105D-686	Radio relay system	☐ D To be established
COMM	1F-105D-692	Transponder/Antenna system	☐ D all
COMM	1F-105D-703	Install AN/ARN-92 Navigation System in F-105D Aircraft (T-Stick II)	☐ D all
COMM	1F-105F-522	Install Improved Wild Weasel III Capability, F-105 Aircraft	* ☐ F * ☐ G
COMM	1F-105F-547 1F-105F-547F 1F-105F-547G	Install AGM-78B (MOD 1) STD ARM Capability, F-105F WW III Aircraft	* ☐ F * ☐ G
COMM	1F-105F-548	Install 14 Channel Video Tape Recorder F-105F WW II STD ARM (MOD 1) Aircraft	* ☐ F * ☐ G
COMM	1F-105F-559	Install Improved SHRIKE Missile Variable Audio Control, F-105F Aircraft	* ☐ F * ☐ G

* Reference T.O. 1F-105-1133

TC TO IDENTIFICATION (Cont)

System or Procedure	Technical Order	Description	TC TO to be complied with on the following aircraft:
ELEC	1F-105-955	Battery condition sensing system	* ☐ D * ☐ F
ELEC	1F-105D-1080 1F-105D-1080C	Installation of Anti-Collision Lights	* ☐ D all * ☐ F * ☐ G
ESCAPE	1F-105-1038 1F-105-1047 1F-105-1083	Force Deployed Parachute Seat retardation system Limb Restraining System	☐ D all * ☐ F all ☐ D all * ☐ F all ☐ D all * ☐ F all
ESCAPE	1F-105-1129	Replacement of Force-Deployed Back-Style Personnel Parachute, P/N 50C7024-22, F-105B/D/F Aircraft and MTS	* ☐ D all * ☐ F * ☐ G
ESCAPE	1F-105F-542	Ejection Seat Assemblies	☐ F all
FIRE CONT	1F-105-992	Improve AN/ASG-19 Gun/Bomb Sight F-105D/F Aircraft	☐ D all * ☐ F * ☐ G
FIRE CONT	1F-105-1050	Installation of Automatic Return to Guns Air to Air, F-105D/F Aircraft and MTS	☐ D all * ☐ F * ☐ G
FIRE CONT	1F-105-1074	Installation of Cockpit Selectable HI-LO Drag Bomb Switch, F-105D/F Aircraft and MTS	☐ D all * ☐ F * ☐ G
FIRE CONT	1F-105D-702	T-Stick II Modification, F-105D Aircraft	☐ D all
FIRE EXT SYS	1F-105-1060	Fire extinguishing system	☐ D all ☐ F all
FUEL	1F-105-997C 1F-105-1044 1F-105-1058 1F-105-1059 1F-105-1061	F-105D Rewire Program Correction of fuel system wiring Install foam in self-sealing fuel cells Install self sealing fuel cells Revised fuel system	☐ D all ☐ D all ☐ F all ☐ D all ☐ F all ☐ D all ☐ F all ☐ D all ☐ F all
FUEL	1F-105-1147	Deactivate Fuel Leak Detector System F-105D/F/G Aircraft and MTS	* ☐ D all * ☐ F * ☐ G
HYD SYSTEM	1F-105-1045 -1049	Emergency hydraulic system Emergency flight control system	☐ D all ☐ F all ☐ D all ☐ F all

* Reference T.O. 1F-105-1133

TCTO IDENTIFICATION (Cont)

System or Procedure	Technical Order	Description	TCTO to be complied with on the following aircraft:
STRUCTURAL	1F-105-1144	Repair of Inboard Wing Pylon Attach Fitting, P/N 57W210505, F-105B/D/F/G Aircraft	☒ D all * ☒ F * ☒ G
STRUCTURAL	1F-105F-537	Modification of Blind Flying Hood	* ☒ F * ☒ G

* Reference T.O. 1F-105-1133

FLIGHT MANUAL AND SUPPLEMENT STATUS

Supplements included in the Flight Manual are listed below. Supplements which are still outstanding are listed on Status Pages of current Safety and Operational Supplements. If you are missing a supplement not included in the Flight Manual, see your Publications Distribution Officer and get your copy. T.O. 0-1-1-4 should be checked periodically to make sure you have the latest supplements and basic manual.

CURRENT FLIGHT MANUAL T.O. 1F-105D-1	DATE 30 June 1969	CHANGED 9 Sep 1970
CURRENT FLIGHT CREW CHECKLIST T.O. 1F-105D-1CL-1	30 June 1969	1 Oct 1970

SAFETY SUPPLEMENTS INCLUDED IN THIS CHANGE

Number	Date	Short Title	F/M Pages Affected
-236	26 Sep 68	Use of Sight Intensity Knob (T.O. 1F-105-992)	2-18

OPERATIONAL SUPPLEMENTS INCLUDED IN THIS CHANGE

Number	Date	Short Title	F/M Pages Affected
-117	13 Aug 68	Blind Flying Hood (T.O. 1F-105F-537)	1-222
-169	7 Apr 70	Installation of Anti-Collision Lights on F-105D Aircraft (T.O. 1F-105-1080C)	1-11, 1-12, 1-48, 1-210, 1-210A

OPERATIONAL SUPPLEMENTS INCLUDED IN THIS CHANGE (Cont)

Number	Date	Short Title	F/M Pages Affected
-171	1 Nov 69	Missile Audio Control (T.O. 1F-105F-559)	1-10, 1-126
-183	2 Dec 69	Thrust Decay System	1-22
-185	14 Nov 69	Nose Wheel Steering System	1-86
-187	29 Dec 69	Flight Limits for SUU-21/A	5-22
-190	26 Jan 70	Flight Limits for BLU-31B with FMU-30/B Fuse	5-20
-193	3 Apr 70	Flight Limits for CBU-24, -29 -49, -53, and -54 Series Stores	5-17 A1-14, A1-15 B1-14, B1-15
-196	6 Apr 70	Flight Limits for AGM-78A/B Missile with LAU-78 and LAU-80 Launchers	5-14
-197	27 Apr 70	Flight Limits for SUU-20 Practice Bomb and Rocket Dispenser	5-30 A1-13
-198	27 Jan 70	Cockpit Changes Due to Revised AGM-78B Missile System (T.O. 1F-105F-547F, -547G)	1-11
-203	23 Jul 70	Arresting Hook/Barrier Limits	3-5

GLOSSARY

Acquisition — The process that occurs between the location of the target in the search phase and the final alignment of the tracking equipment on the target.

ADI — Attitude Director Indicator.

ADL — Armament Datum Line — Boresight line for both electrical and mechanical equipment. Horizontally depressed from fuselage reference line 26.14 mils ($1^{\circ} 28' 12''$).

AFCS — Automatic Flight Control System.

AGL — Above Ground Level — Aircraft absolute altitude.

Altitude Hole — Area of no return in lower portion of radar scope presentation. Represents distance (altitude) from the radar transmitter to the earth's surface.

Altitude Set — R-14 control for delaying start of radar range sweep to compensate for time required for radar energy to travel to nearest reflecting surface and return.

AMI — Airspeed Mach Indicator.

Angle Track — The act of automatic positioning of the radar antenna so as to maintain an airborne target, to which the radar set has "locked-on," along the centerline of the radiation pattern.

Antenna Tilt — A control for manually establishing the scanning level of the radar antenna with respect to the local horizontal.

AR — Air Refueling.

Attenuation, Atmospheric — Loss of radar energy in both the transmitted and reflected portions due to atmospheric absorption.

Attenuation, Range — Loss of radar energy due to angular spread of the broadcast beam and to the omnidirectional spread of reflected radar energy from randomly oriented surfaces.

ATM — Air Turbine Motor.

AVVI — Altitude Vertical Velocity Indicator.

Azimuth Cursor — An electronically generated line on the radar scope for the purpose of indicating ground track.

Azimuth Error — That signal in the radar azimuth reception channel that, when interrogated with respect to phase and amplitude, provides a measure of the horizontal angle off the radiation pattern (antenna) centerline of the reflecting surface (target) that is producing the signal.

Beam Width — Width of the sector of effective radiation (or effective pick-up) of a radar antenna. Measured in degrees between the direction left of the radiation pattern centerline where the radar energy is half the strength of energy along the centerline to the corresponding direction right of centerline.

Beam Width Error — Distortion of radar returns in the azimuth dimension due to angular spread of the beam.

Beam Width Occupancy — Percent of radar beam in the azimuth dimension that is subtended by a reflecting surface.

Bezel Brilliance — A control for varying the intensity of illumination given the marks and numerals etched in the plastic screen in front of the radar scope face.

BIP — Blind Identification Point.

Bore Sight Line — See ADL.

BTIP — Blind Target Identification Point.

CADC — Central Air Data Computer.

Cardinal Effect — Elongation and intensification of radar returns due to multiple reflection from a line of buildings which simultaneously present a surface perpendicular to the radar beam. Due to the cardinal point layout of many cultural features (city streets, section lines, country roads, etc.) this effect is usually noticed as the radar antenna sweeps through a cardinal bearing over areas of cultural development.

Cathode Ray Tube (CRT) — A vacuum tube in which the electrons emitted from the cathode are focused on a fluorescent coating at the opposite end of the tube causing a visible glow at the point which they strike. See Radar Direct Flight Indicator.

CIN — Communication-Identification-Navigation.

Clearance Plane — An imaginary plane in space, established by a computer associated with the radar set, and oriented either parallel to the local earth horizontal or parallel to the aircraft flight path. The radar set discriminates against reflections from objects below this plane and portrays on the scope only those illuminated surfaces that protrude above the clearance plane.

Clutter Eliminator — A radar control that, when turned on, causes the radar set to discriminate against massive returns so that only the leading edge of these returns are portrayed on the scope. (Effective in Search and Attack mode only.)

Cursor Brilliance — A radar control for varying the intensity of the azimuth cursor and artificial horizon independently of other scope signals.

CVDA — Continuously Variable Depression Angle.

CVMAS — Continuously Variable Mechanical Advantage Shifter.

C/W — Time Compliance Technical Order complied with.

Elevation Error — The signal in the radar elevation reception channel which, when interrogated with respect to phase and amplitude, provides a measure of the vertical angle-off radiation pattern (antenna) centerline of the reflecting surface (target) that is producing the signal.

Elliptical Scan — The pattern described by the radar radiation in blind acquisition mode in which the centerline of the antenna moves in a rectangular pattern 10 degrees in azimuth and 4 degrees in elevation.

EPR — Engine Pressure Ratio.

Fail-Safe Gate — An electronically generated radar scope signal portrayed as a bright arc concentric to the sweep origin (vertex) in terrain avoidance mode. Its presence as a solid arc indicates that the radar transmitter, receiver and terrain avoidance computer are all working properly. As a dashed line it indicates malfunction of the transmitter and when absent indicates malfunction of the receiver or the terrain avoidance computer.

Flight Path — The line or plane that describes the longitudinal motion of the aircraft and usually expressed in terms of the angle which this line or plane makes with the longitudinal axis of the aircraft. (Aircraft attitude minus angle of attack.)

Glitter — Momentary non-persistent appearance or intensification of radar returns from objects that are otherwise of low radar significance due to their momentarily presenting a surface exactly perpendicular to the radar beam.

Great Circle Course — The intended horizontal direction of travel that describes the shortest distance between two points on the face of the earth. It is an arc of the earth's circumference, the plane of which passes through the center of the earth. Examples of great circles are the equator and all lines of longitude.

Gross Altitude — Aircraft altitude above sea level. The gross altitude scale limits extend beyond the aircraft altitude capability.

Ground Range — The horizontal distance from the point directly below the aircraft to the target.

Horizon Bars — Electronically generated artificial horizon portrayed as a radar scope feature.

HSI — Horizontal Situation Indicator.

IFIS — Integrated Flight Instrument System.

Inherent Errors — Three physical characteristics of a radar set (beam width error, pulse length error and spot size error) that makes it impossible to portray radar returns on an exact scale with the reflecting objects.

Intensity — A radar control for varying the brightness of all electronically produced radar scope features by varying the acceleration given the electron beam.

Line of Sight — Description of the path taken by radar energy, i.e., a straight line from the radar antenna to the reflecting surface and back. Objects not in the line of sight whether beyond the horizon or hidden by an intervening object cannot be detected by the radar.

MAC — Mean Aerodynamic Chord.

Memory — A radar control for varying the length of time that images persist on the scope. Accomplished by varying the rate at which negative electrical pulses are sent through the memory screen to eliminate the electrostatic "holes" caused by penetration of electrons from the write gun thus stopping further flow of electrons through those holes from the flood gun.

MER — Multiple Ejector Rack.

MIL — An angular measurement which subtends 1 foot at 1000 feet (17.78 mils in 1 degree).

Monopulse Resolution Improvement (MRI) — The apparent reduction of beam width error of radar images accomplished by subtracting azimuth error signals from signal profiles in the range reception channel.

N/C/W — Time Compliance Technical Order not complied with.

Non-Reflecting Target — An area that reflects no radar energy back to the antenna either because all the energy is absorbed or because the area has no surface perpendicular to the radar beam

consequently reflecting all the energy away from the antenna.

One-Bar Scan — Radar antenna searching pattern in which the right-to-left motion of the antenna is at the same level with respect to the horizontal plane of the aircraft as is the left-to-right motion.

Parabolic Reflector — A dish-shaped reflecting surface that is a paraboloid of revolution. Such a surface, when struck by beams parallel to the axis of revolution will reflect in parallel beams, all energy emanating from the focus.

Pencil Beam — A tightly focused radar beam. In the R-14, pencil beam refers to a conically shaped beam with a spread of 3.6° in azimuth and 6.2° in elevation.

Plan Position Indicator (PPI) — A type of radar presentation in which the illuminated area is depicted in maplike perspective with the position of the aircraft being represented by the center of sweep rotation (the apex of a sector when the radar antenna scans less than 180°).

Pointer System — A procedure used in radar scope interpretation in which a difficult target is located by projecting through easily identified returns, two or more imaginary lines, which meet at or near the location of the target in question.

Pulse Length — The transmission time of a radar set expressed in microseconds or the distance in feet that the leading edge of the transmitted pulse travels in space before the transmission is cut off.

Pulse Length Error (PLE) — The distortion of radar returns in the range dimension due to the difference in time for the leading edge of the radar pulse to be reflected from an object and for the trailing edge to be reflected.

Pulse Recurrence Frequency (PRF) — The number of times per second that a radar set transmits.

Radar Acquisition — That phase of an airborne radar interception in which the operator prepares to "lock-on" a target identified on the radar scope. Initiated by depressing the action/reject button on the throttle to reduce the searching of the antenna to a small area about the target while manually ranging the range cursor by rotation of the throttle grip.

Radar Bombing — Releasing a bomb at a target identified on the radar scope without the aid of visual observation of the target.

Radar Direct Flight Indicator — A complete viewing installation which includes a cathode ray tube, mount, enclosure, bezel, lights, indicators, controls and wiring connections for display of radar intelligence. Often includes a memory device to provide for retention of the displayed information and to improve readability in daylight. Also called a radar scope.

Radar Mile — A unit of time (12.4 microseconds) that is required for a pulse of radar energy to be transmitted one nautical mile and be reflected back to the receiver.

Radar Return Persistency — The ability of the radar return to remain visible and identifiable at various ranges.

Radar Shadow — The area of no return, on the radar scope, from the region into which radar energy cannot penetrate because of the line of sight characteristics of the radar beam.

Radar Significant Area — An area that has the capability to provide a bright, persistent and easily identifiable radar scope display.

Radar Silence — The period of time when the radar transmitter is in standby position and not transmitting.

Radar Target — The radar return that has been designated as the objective of the mission.

Radar Target Intelligence — Evaluated information which facilitates the neutralizing of selected targets through the employment of airborne radar for navigation, reconnaissance and bombardment.

Radiation Pattern — A description of the distribution of energy in the radar beam. Also the physical limits of the beam (from half power point to half power point) expressed in degrees of elevation (vertical spread) and azimuth (horizontal spread). Also the physical limits of the volume of space swept over by the radar beam during one cycle of antenna rotation (expressed in degrees of elevation and azimuth).

Range Cursor — An internal electronic radar signal recurringly generated at some specific time after

each radar pulse transmission appearing on the scope as a solid arc representing a specific slant range.

Range Rate Circle — An electronic, internally generated radar signal presented on the scope in the form of a bright circle approximately 3 inches in diameter and having a gap or break in the circle about 3/8-inch long. The location of this gap, which may appear anywhere between the 1030 o'clock position clockwise to the 6 o'clock position, represents the rate of closure or rate of separation between the aircraft and in airborne target to which the radar is "locked."

Range Scale — Referring to one of the three range presentations available with the R-14 radar. The R-14 scope has a usable diameter of 3.76 inches on which may be portrayed 80 miles range, 40 miles range or 13.3 miles range.

Range Sweep — The motion of the electron beam in a cathode ray tube that permits target blips and range cursors to be distributed across the face of the tube in proportion to their slant ranges. At any given instant the distance of the electron beam from the zero reference point on the scope is proportional to the round trip distance that the last pulse of transmitted energy has been able to travel.

RAT — Ram Air Turbine.

Receiver Gain — A radar control for varying the amount of amplification given returned signals.

Resolution — The ability of a radar set to show separation between adjacent reflecting targets.

RIP — Radar Identification Point.

Signal Potential — The ability of an area to reflect radar energy.

Signal Strength — Level or size of the return on the radar scope.

Slant Range — Line of sight distance from aircraft to target.

Spoiled Beam — In the R-14 radar a mode of operation in which the radar energy is broadcast in a beam which is 3.6° in azimuth and approximately 55° in elevation.

Spoiler — A movable section of the radar antenna reflector which may be used to spoil (spread) the broadcast energy to give the optimum distribution of that energy to achieve a desired scope presentation of the area illuminated.

Spot Size — The physical diameter of the electron spot that "paints" the picture on the face of the radar scope.

Spot Size Error — The distortion of a radar return caused by the size of the electron spot on the face of the radar scope.

Sweep Delay — A circuit in radar which controls the starting time of the range sweep motion of the electron beam in the indicator (CRT). In the R-14 this circuit is controlled by the altitude set knob and is used to eliminate that portion of slant range that represents the absolute altitude of the aircraft. This circuit also distorts the rate of movement of the electron beam so that target images are displayed on the scope in proportion to their ground ranges.

TBC — Toss Bomb Computer.

Time Sharing — A circuit in the R-14 radar for proportioning the time of application of the various pieces of intelligence that must be portrayed electronically on the radar scope in such a way that the presentation appears continuous to the operator.

Total Azimuth Error (TAE) — A combination of spot size error and beam width error as applied in azimuth to the reflecting object.

Total Range Error (TRE) — A combination of spot size error and pulse length error as applied in range to the reflecting object.

True Horizontal — At any given location on the surface of the earth it is any plane which is perpendicular to a line through that location and through the center of the earth. It is the zero reference plane from which attitude angles are measured.

Two-Bar Scan — Describing the motion of the antenna of the R-14 radar in Search and Attack mode of operation. The antenna sweeps 90° in azimuth but in sweeping left to right it sweeps four degrees higher in elevation (measured with

respect to the longitudinal axis of the aircraft) than on the right-to-left sweep. The 6.2° vertical spread of the radar beam results in a 2.2° overlap of the two sweeps.

VAI — Variable Air Inlet.

Video — In radar a term referring to target intelligence that has been processed by the receiver and is in a form suitable for application to the radar scope.

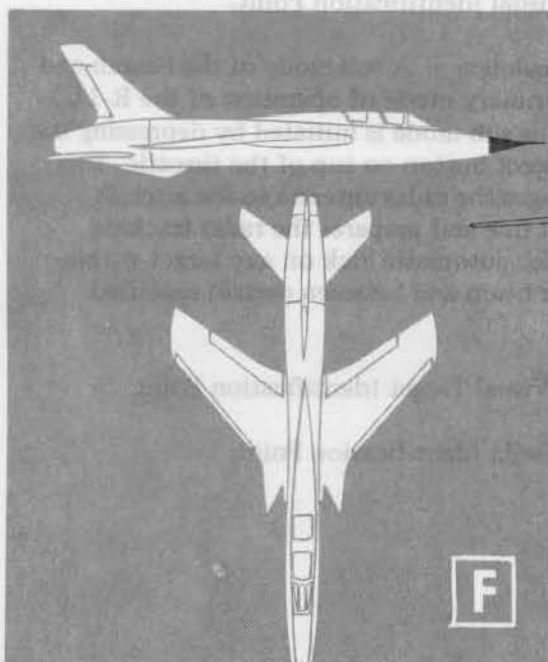
Video Pedestal — An R-14 radar control which varies the amplification characteristics of the indicator circuit which is responsible for the presentation of target images and the range cursor.

VIP — Visual Identification Point.

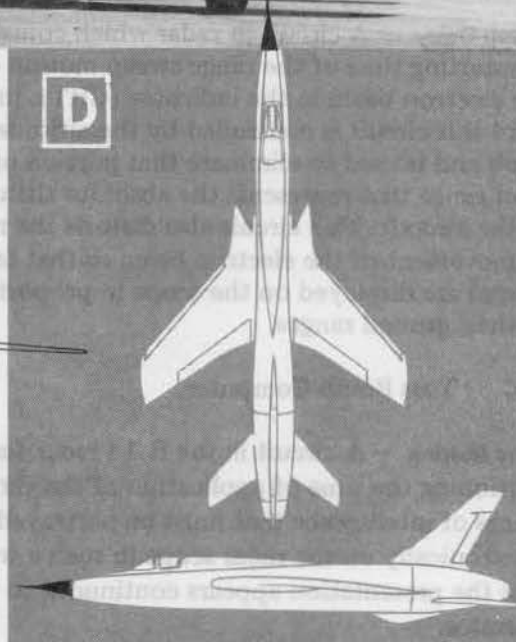
Visual Acquisition — A sub-mode of the Search and Attack primary mode of operation of the R-14 radar. This sub-mode is initiated by depressing the action/reject button on top of the throttle. This action cages the radar antenna to the aircraft boresight line and prepares the radar tracking circuits for automatic lock on any target within the radar beam and between certain specified ranges.

VTIP — Visual Target Identification Point.

Δ IP — Delta Identification Point.



F
US AF
105



**ALL WEATHER
FIGHTER-BOMBER**

and TRAINER



Section I

DESCRIPTION

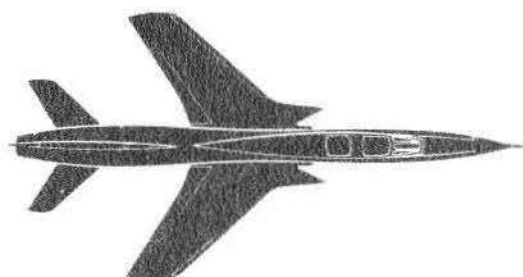


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GENERAL ARRANGEMENT

GROUND SERVICE UNITS — SEE FIGURE 1-78

ANTENNA LOCATIONS — SEE FIGURE 1-41

T.O. 1F-105D-1

1. Ammunition Drum
2. Air Refueling Receptacle & Probe
3. ATM (Air Turbine Motor)
4. Optical Sight
5. Ejection Seat
6. ☐ ONLY Rear Ejection Seat
7. Forward Fuel Tank
8. Main Fuel Tank
9. LE Flap
10. TE Flap
11. Aft Fuel Tank
12. Engine
13. Water Tank
14. Position Lights (3)
15. Rudder
16. Drag Chute Compt
17. Speed Brakes
18. Stabilizer
19. Arresting Hook
20. Aileron
21. Wing Pylon Tank
22. Spoilers
23. Taxi Light ☐ Landing Light
24. Centerline Pylon Tank

25. Bomb Bay Tank
26. Aux Electronic Compt
27. External Electrical Power Receptacle
28. Left Electronic Compt
29. Landing Light ☐ Taxi Light
30. Battery
31. M-61 Gun
32. Liquid Oxygen Converter
33. Fwd Electronic Compt
34. Pitot Boom

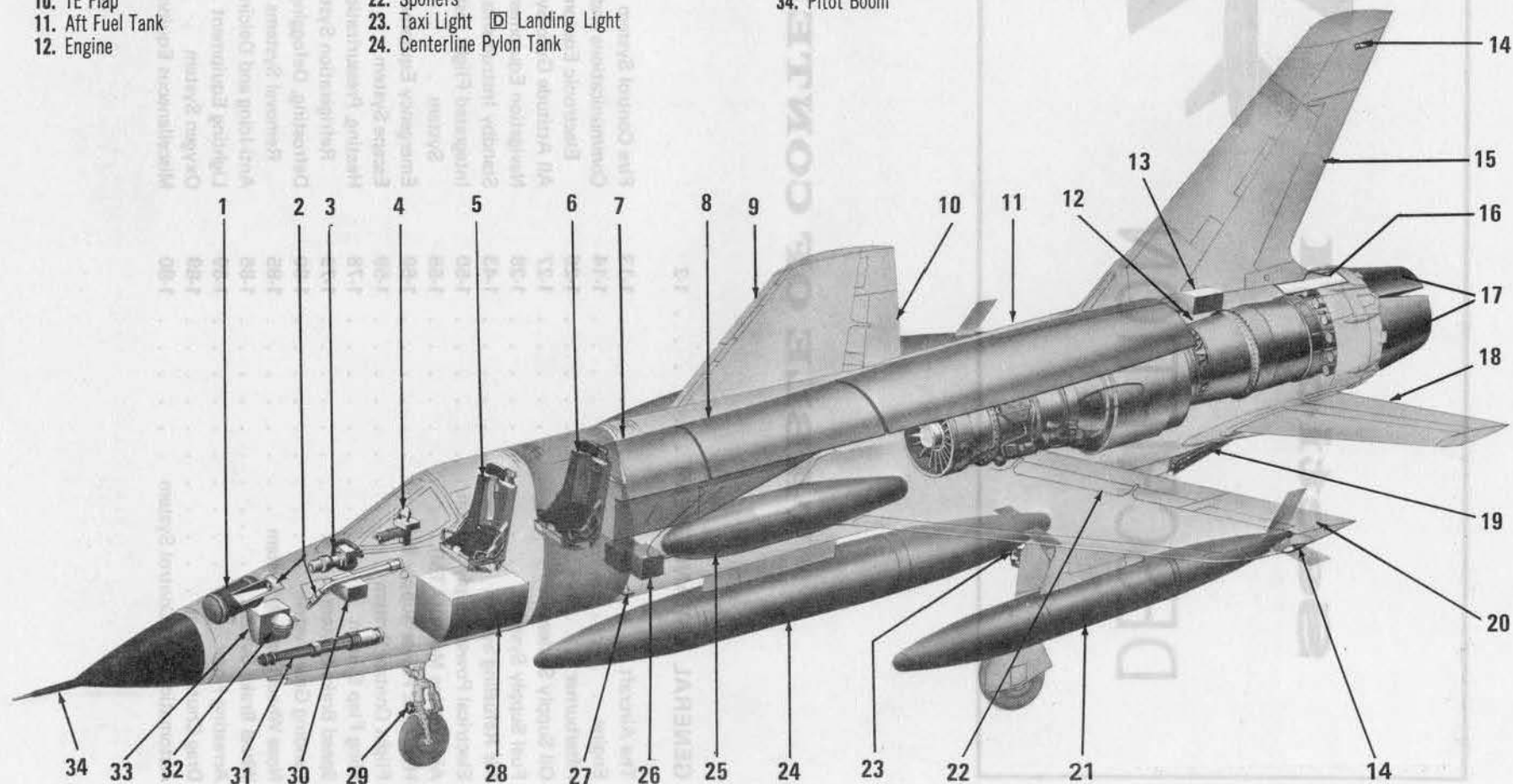


Figure 1-1

ENGINE J-75

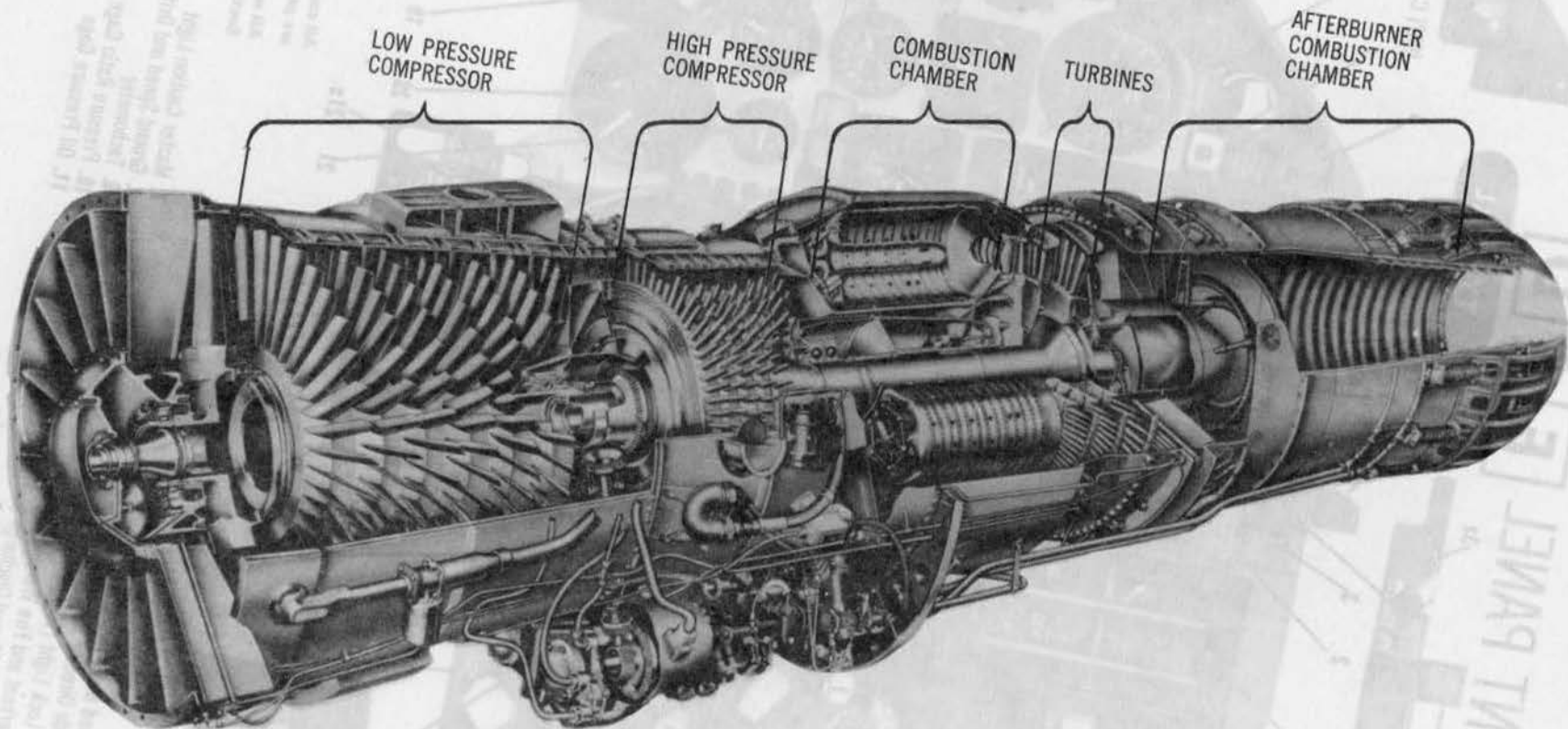
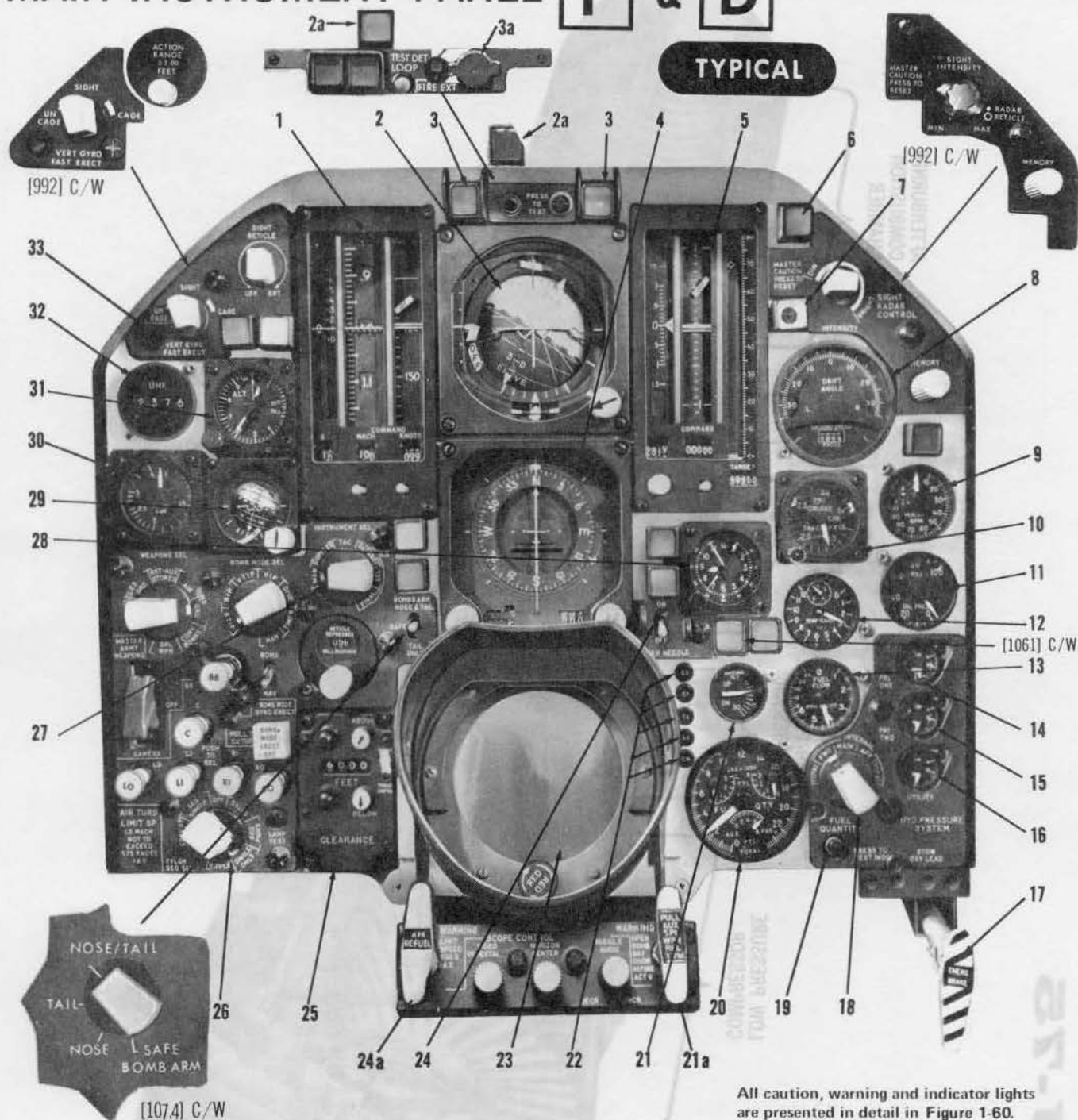


Figure 1-2

MAIN INSTRUMENT PANEL **F** & **D** front



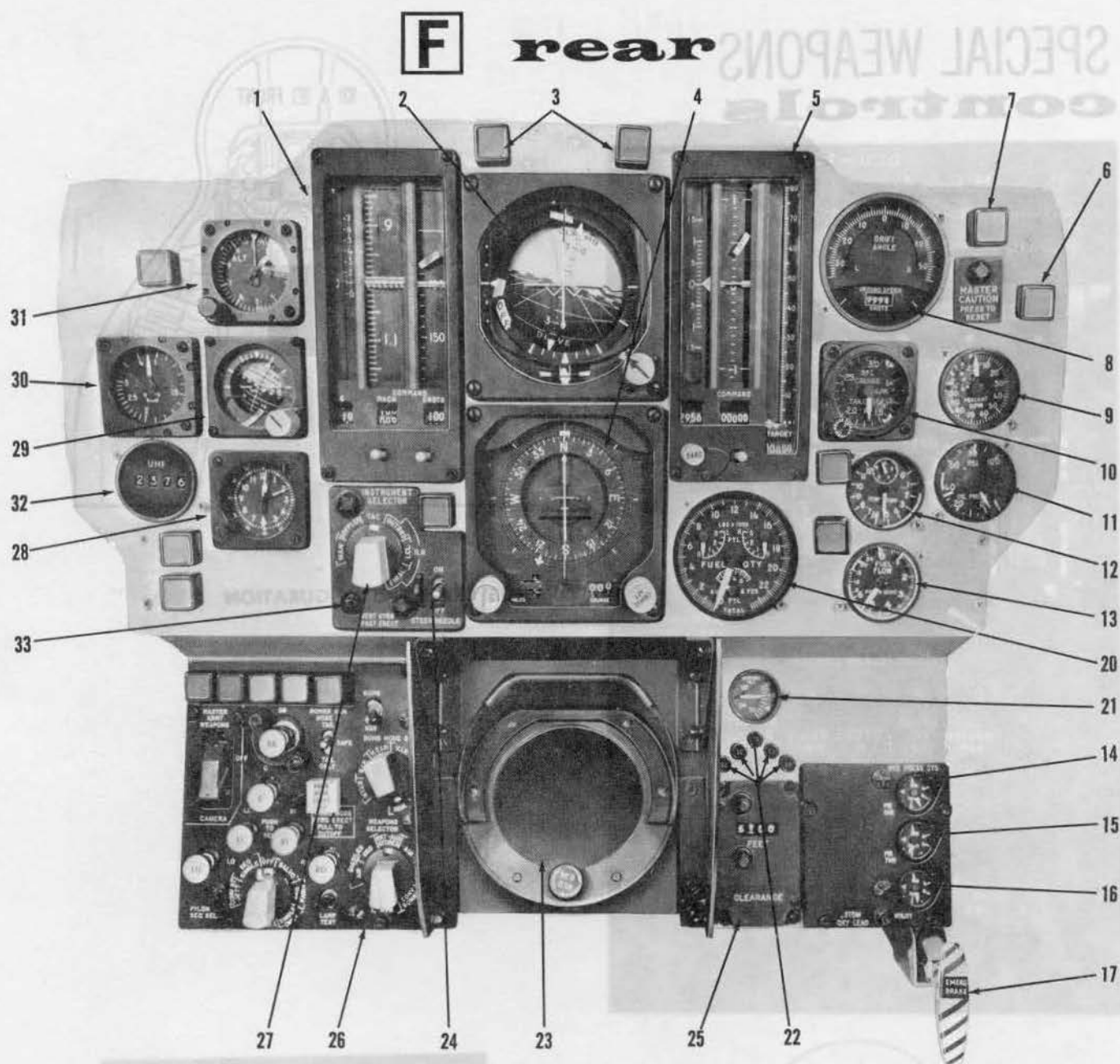
All caution, warning and indicator lights are presented in detail in Figure 1-60.

All armament controls are presented in Section I.

1. AMI (Airspeed Mach Indicator)
2. ADI (Attitude Director Indicator)
- 2a. Stabilizer Lock Light [1045] C/W
3. Engine Overheat and Fire Warning Lights
- 3a. Fire Extinguishing Manual Discharge Switch [1060] and [1060D] C/W
4. HSI (Horizontal Situation Indicator)
5. AVVI (Altitude-Vertical Velocity Indicator)
6. Bail-Out Light (F) only

7. Master Caution Light
8. Ground Speed and Drift Angle Indicator
9. Tachometer
10. Pressure Ratio Gage
11. Oil Pressure Gage

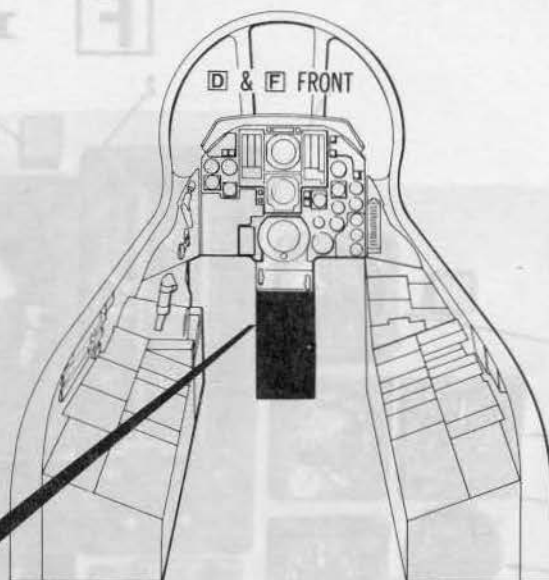
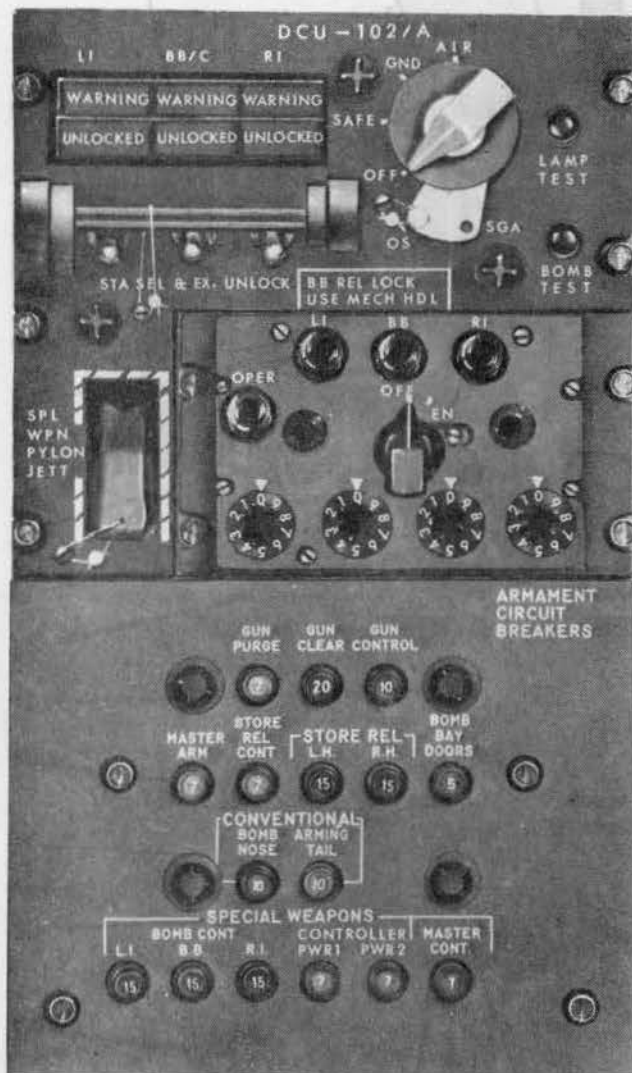
Figure 1-3 (Sheet 1 of 2)



- | | |
|--|--|
| 12. Exhaust Gas Temperature Gage | 24. Steering Bar (Needle) Switch |
| 13. Fuel Flow Indicator | 24a. Air Refuel Handle |
| 14. Hydraulic Pressure Gage (PRI One) | 25. Clearance Plane Indicator |
| 15. Hydraulic Pressure Gage (PRI Two) | 26. Armament Control Panel |
| 16. Hydraulic Pressure Gage (Utility) | 27. Instrument Selector Switch |
| 17. Emergency Brake Handle | 28. Clock |
| 18. Fuel Quantity Selector Switch | 29. Standby Attitude Indicator |
| 19. Fuel Quantity Test Button | 30. Standby Airspeed Indicator |
| 20. Fuel Quantity Indicator | 31. Standby Altimeter |
| 21. Antenna Tilt Indicator | 32. Remote Channel Indicator |
| 21a. Auxiliary Special Weapon Release Handle | 33. Vertical Gyro Fast Erection Button |
| 22. Radar Mode Indicator Lights | |
| 23. Radar Scope | |

Figure 1-3 (Sheet 2 of 2)

SPECIAL WEAPONS controls



"ORANGE CRATE" CONFIGURATION

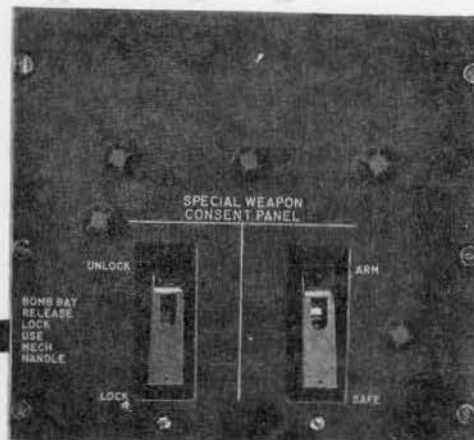
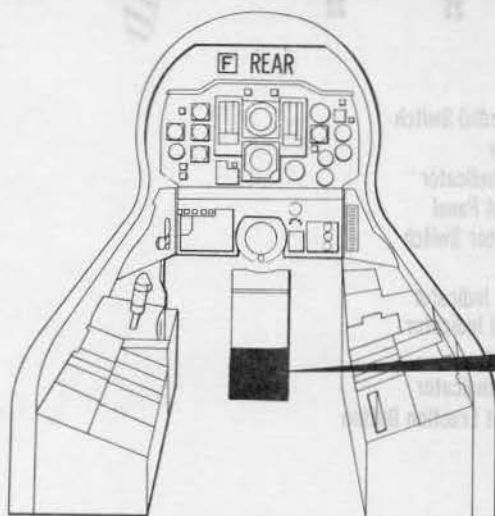


Figure 1-4

AUXILIARY INSTRUMENT PANELS

D & F

TYPICAL
LEFT

DRAG CHUTE HANDLE



All caution, warning and indicator lights are presented in detail in Figure 1-26.

AIR REFUELING LIGHTS AND RESET BUTTON

LANDING GEAR HANDLE



LANDING GEAR DOWNLOCK OVERRIDE SWITCH

RIGHT

LANDING & TAXI LIGHT SWITCH

ANTI SKID SWITCH

ARRESTING HOOK SWITCH

JETTISON EXTERNAL STORES BUTTON

LANDING GEAR POSITION INDICATOR LIGHTS

GEAR WARNING LIGHT AND BEEPER TEST SWITCH

EMERGENCY LANDING GEAR EXTENSION HANDLE

D ONLY

VIDEO PEDESTAL KNOB

CAUTION LIGHT PANEL

AC AND DC ELECTRIC POWER CONTROL PANEL

CAUTION LIGHTS TEST BUTTON

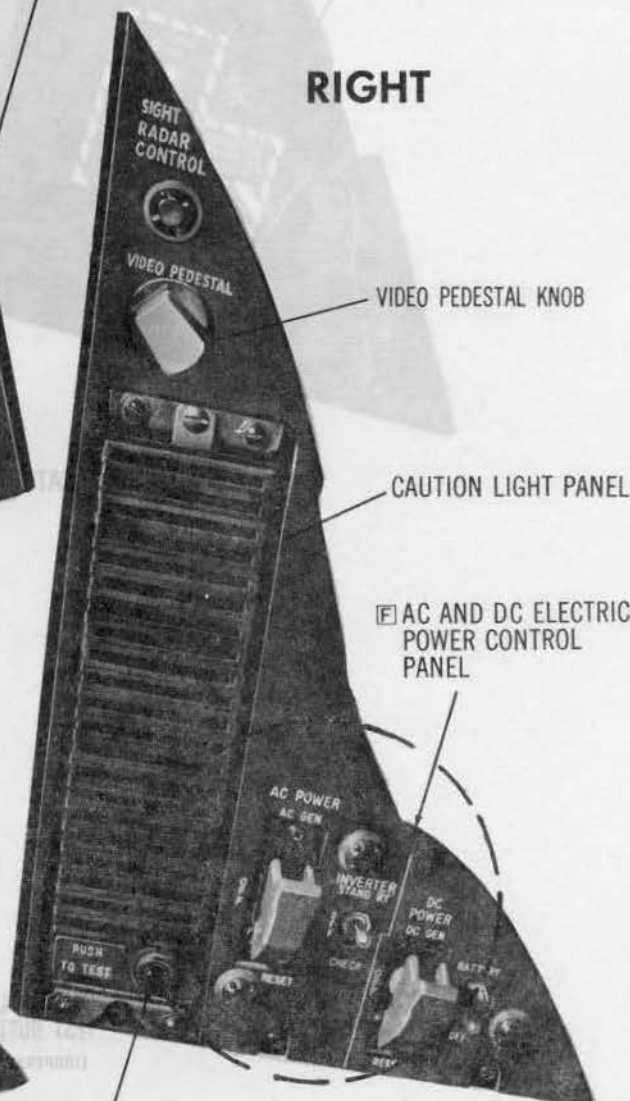


Figure 1-5 (Sheet 1 of 2)

F rear

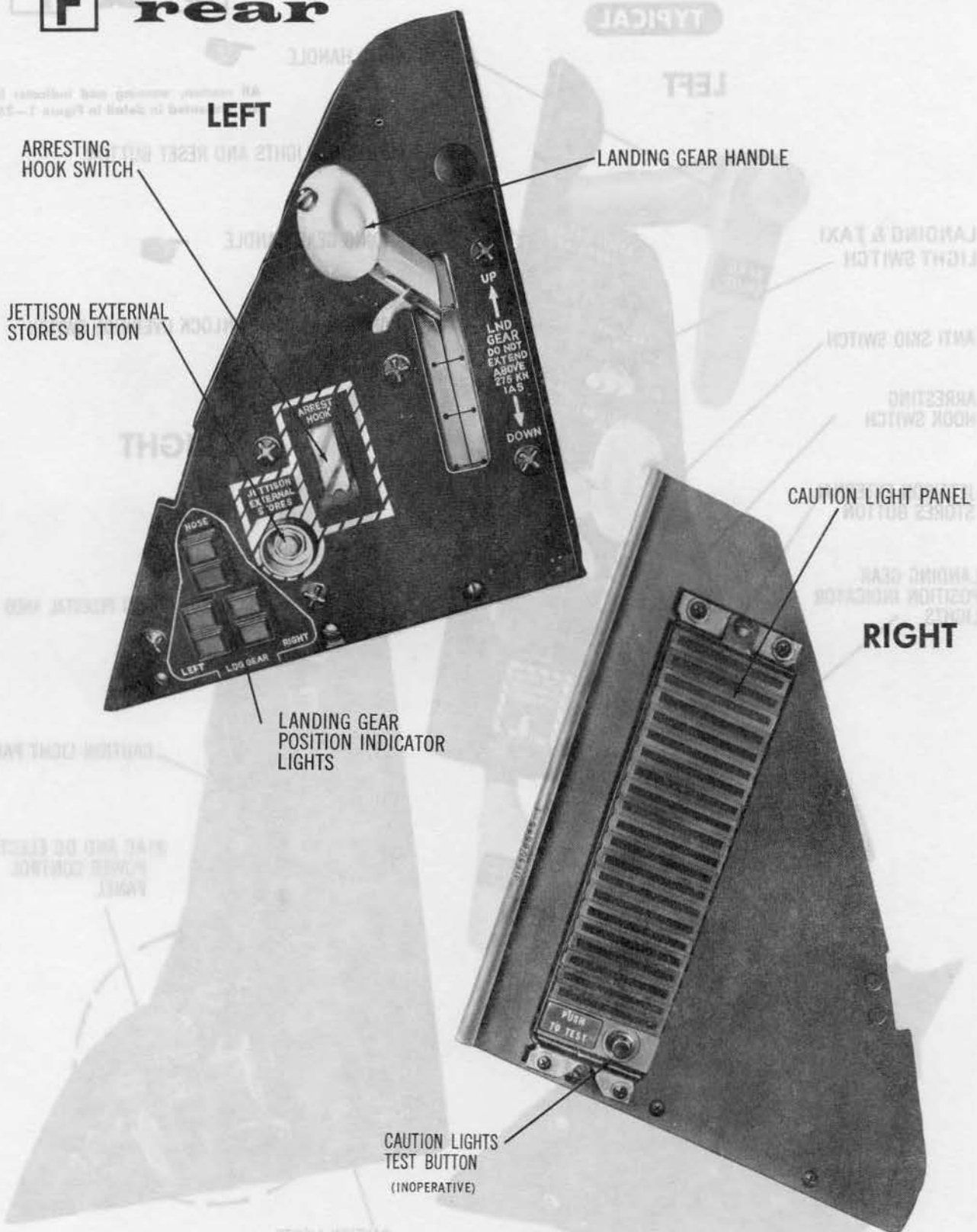
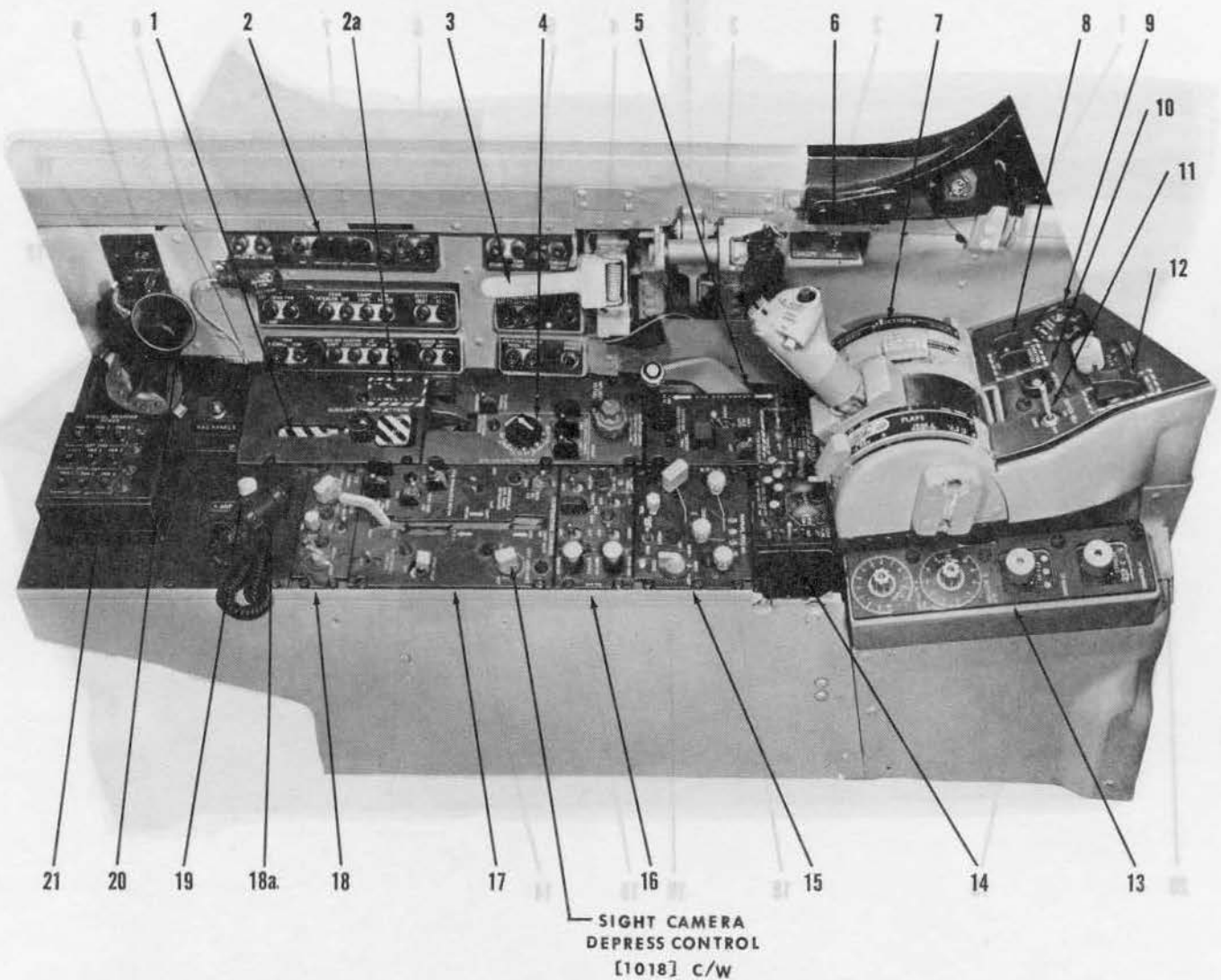


Figure 1-5 (Sheet 2 of 2)

LEFT CONSOLE **TYPICAL**

D**F****front**

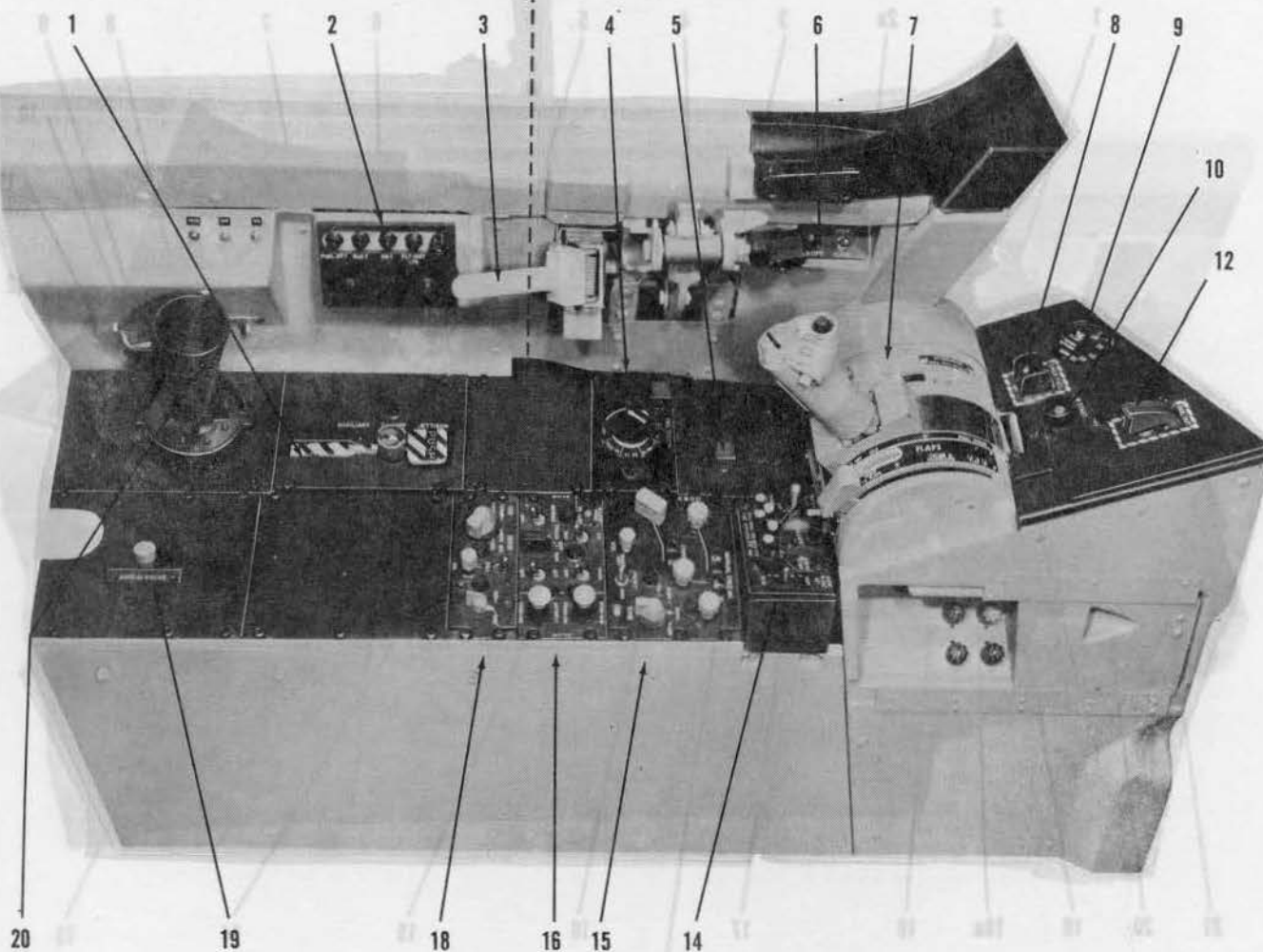
1. Auxiliary Canopy Jettison Handle
2. Circuit Breaker Panel
- 2a. Alternate Engine Fuel Feed Switch [1061] C/W
3. Canopy Lock Lever
4. Fuel System Control Panel
5. Flight Control Panel
6. Interior Canopy Control Switch

7. Throttle Quadrant
8. Emergency Fuel System Switch
9. Flap Position Indicator
10. Air Start Button
11. Water Injection Switch
12. Bail-Out Light Switch (F Only)

Figure 1-6 (Sheet 1 of 2)

TYPICAL

LEFT CONSOLE



- 13. Toss Bomb Computer Controls
- 14. Radar, R-14, Control Panel
- 15. Command Radio, AN/ARC-70, Control Panel
- 16. AFCS Control Panel
- 17. Temperature Control Panel
- 18. Interphone, AN/AIC-20, Control Panel
- 18a. Cockpit Utility Light [F] [890] C/W

- 19. Anti-G Suit Valve Test Button
- 20. Pilot's Relief Container
- 21. Special Weapons Circuit Breaker Panel
- 22. [F] Missile Audio Control

NOTE

[F] ONLY, items 20 and 21 are interchanged.

Figure 1-6 (Sheet 2 of 2)

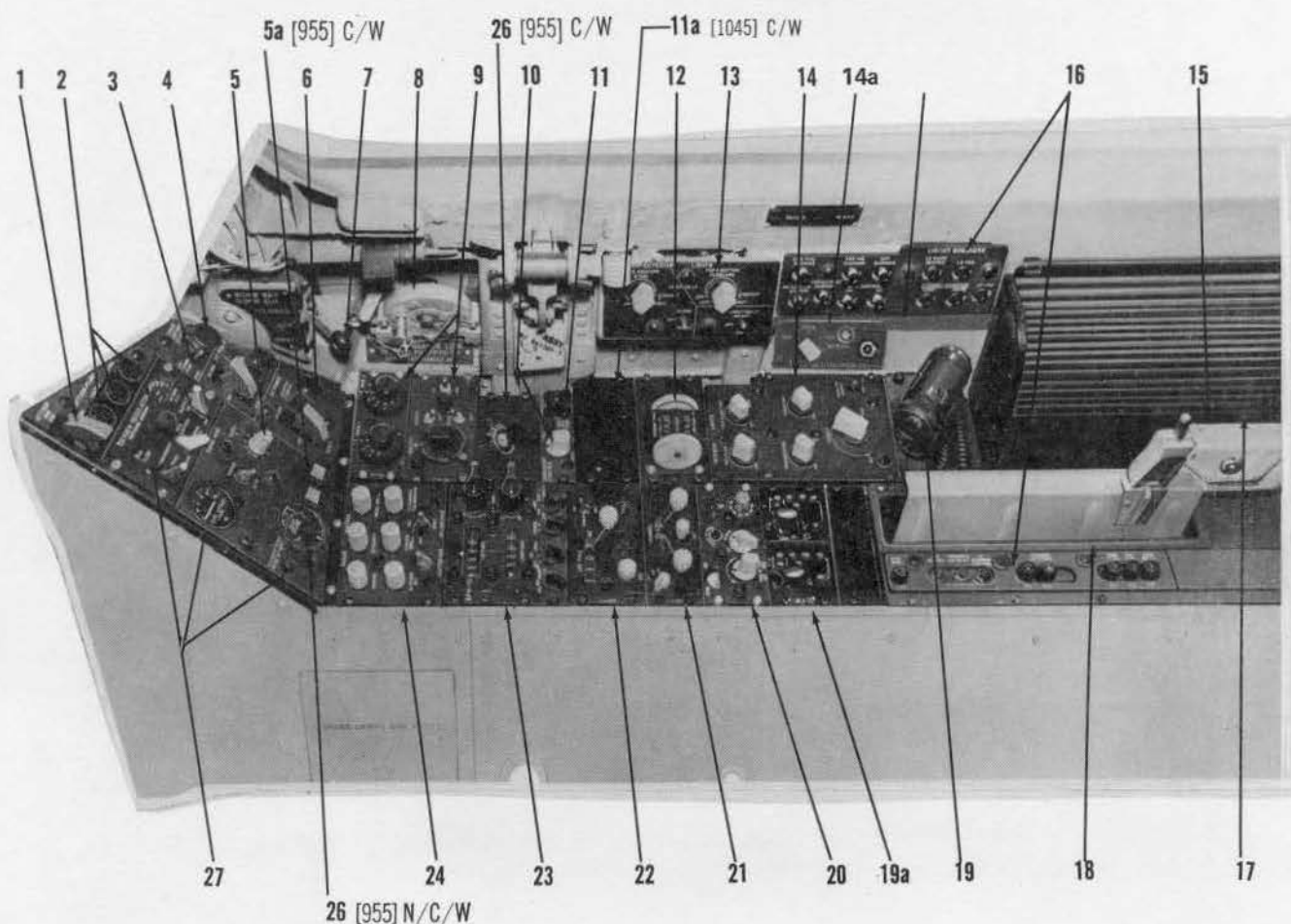
RIGHT

console

TYPICAL



[D-702 N/C/W]



1. Inboard MER Jettison Switch [D] and [F] [F-540] [F-547F] or [F-547G] N/C/W
ECM Destruct System Arm Switch [F] [F-540] C/W, [F-547F] or [F-547G] N/C/W
AGM-78B Emergency Firing Switch [F] [F-547F] or [F-547G] C/W.
2. Pylon Jettison Buttons
3. ATM Switch
4. Cartridge Start Button
- 4a. Main Airline Shutoff Valve Switch
- 4b. Liquid Oxygen Quantity Gage
- 4c. Main Hot Air Line Overheat Light
5. Range Wind Panel
- 5a. Battery High Charge and High Voltage Caution Lights [955] C/W
6. DC and AC Electric Power Control Panel [D] ONLY
7. Bomb Bay Door Auxiliary Handle
- 7a. ATM Air Line Overheat Light
8. Special Weapon Lock
9. IFF/SIF Control Panels
- 9a. ECM Destruct System Arm Switch [F] [F-547F] or [F-547G] C/W
10. CVDA Knob
11. CADC Self Test Switch
- 11a. Emergency Pitch and Roll Control Switches [1045] C/W
12. Timer Control
- 12a. AGM-12B Transmitter Test Panel
13. Exterior Lights Control Panel
14. Interior Lights Control Panel
- 14a. Anti Collision Lights Panel [1080] [1080C] C/W
15. Flight Status Safety Pin Pouch
16. Circuit Breaker Panel(s)
17. Map Case
18. Plotting Board
19. Cockpit Utility Light all [D] and [F] [890] N/C/W
- 19a. ECM Control Panel [890] C/W
20. Compass Control Panel
21. Tacan AN/ARN-62, Control Panel
22. ILS, AN/ARN-61, Control Panel

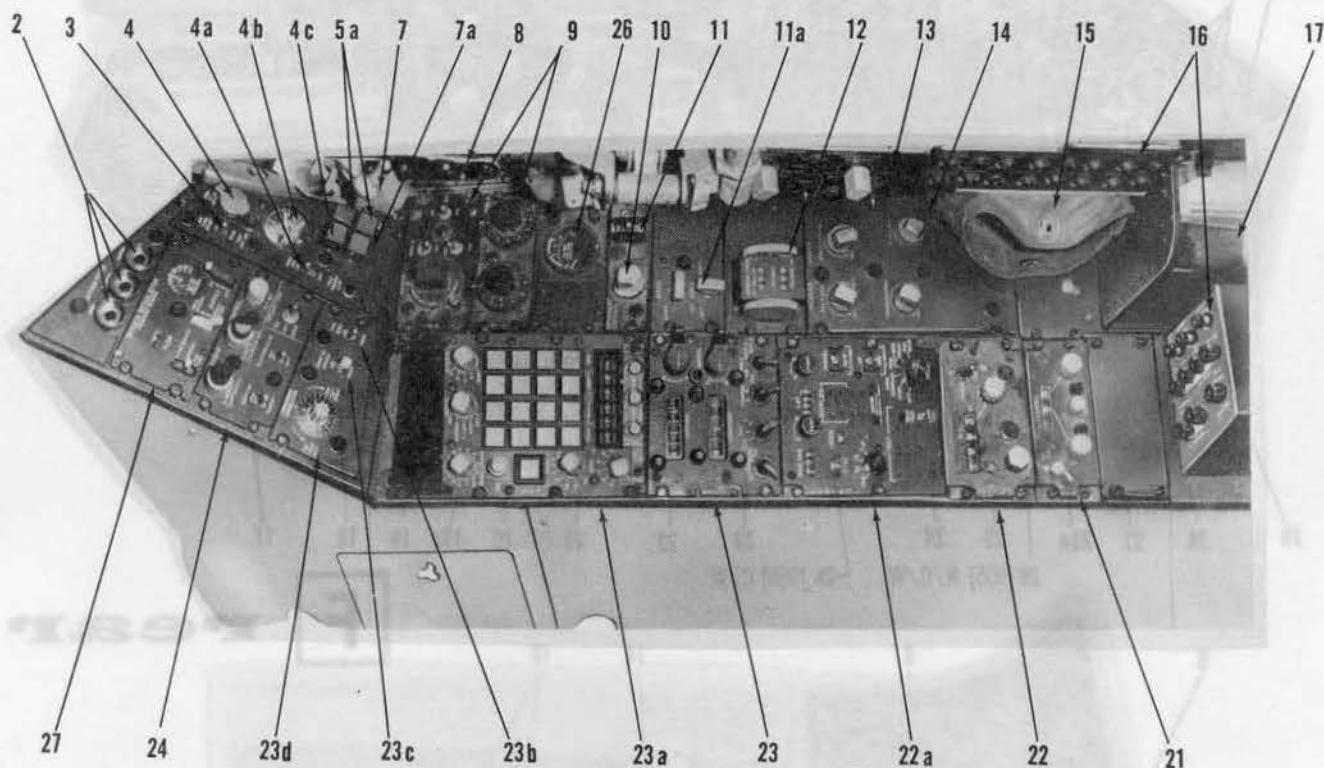
Figure 1-7 (Sheet 1 of 2)

RIGHT console

TYPICAL

D

[D-702] C/W



- 22a. GAVRS Control Panel
- 23. Doppler, AN/APN-131, Control Panel
- 23a. Loran Control Panel
- 23b. FPA Zero Switch
- 23c. Sight AZ Switch
- 23d. Crosswind Correction Control
- 24. Radar, R-14, Control Panel
- 25. Control Transfer Panels (☐ Only)
- 26. Displacing Gear Pressure Indicator
- 26a. ☐ [948] C/W, Test Airline Overheat Sensor Button
- 27. Oxygen System Control Panel
- 28. Aft Radar Scope Deactivate Switch (☐ Only)
- 29. Flight Instrument Simulate Failure Switch (☐ Only)

Figure 1-7 (Sheet 1A of 2)

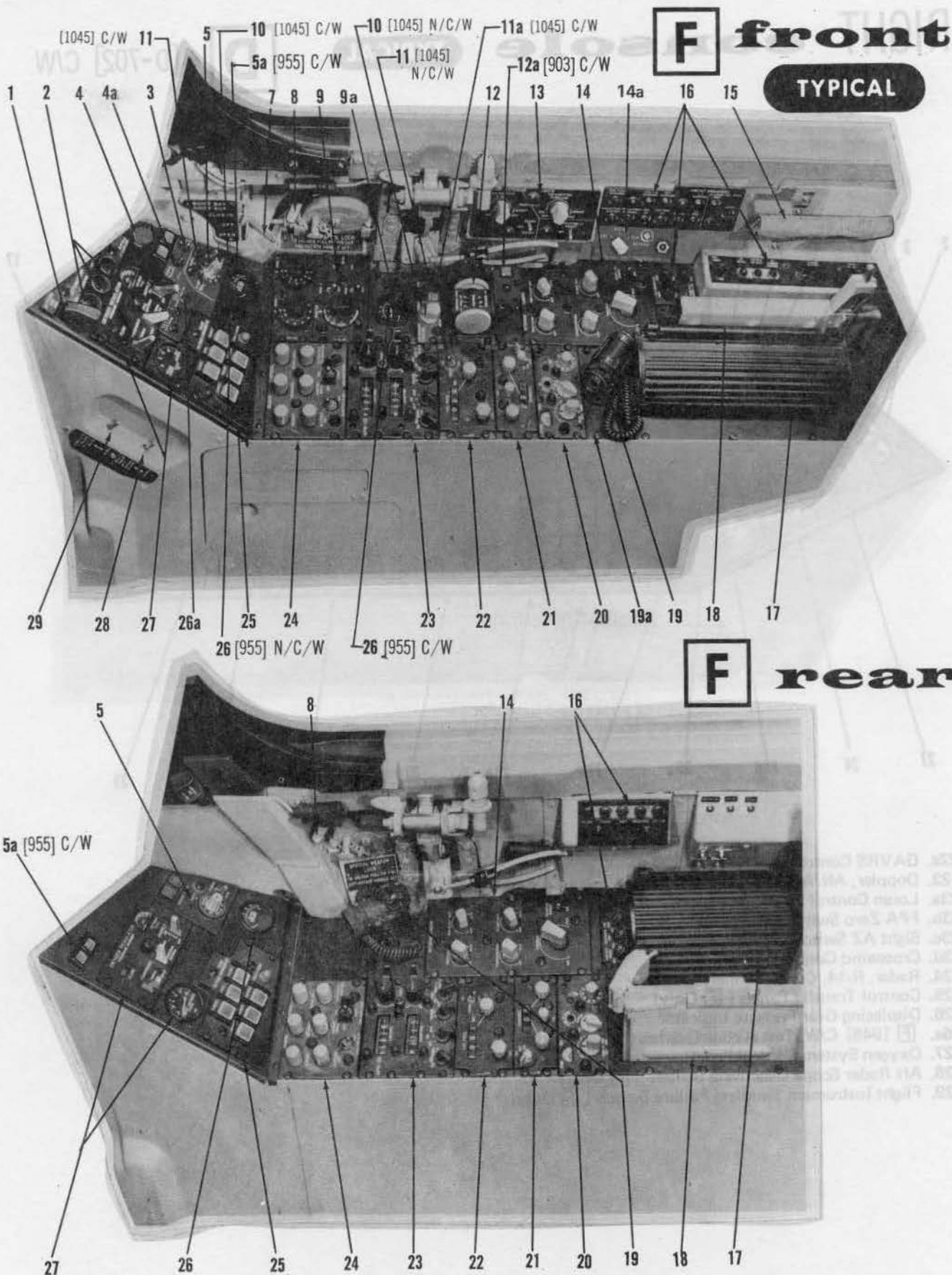


Figure 1-7 (Sheet 2 of 2)

THE AIRCRAFT.

The F-105D single-place and the F-105F/G two-place all weather supersonic fighter bombers are manufactured by the Fairchild Hiller Corporation, Republic Aviation Division, Farmingdale, New York. Minimum crew complement is one pilot. Design of the F-105F/G front cockpit is nearly identical to the F-105D cockpit. Similarity of flight characteristics and operating procedures, allows a pilot qualified in either aircraft to fly the other with a minimum of retraining. The F-105F rear cockpit is equipped with dual controls and indicators for training in instrument flight, fire control and weapon delivery procedures and for proficiency evaluation for standardization of techniques. In the F-105F the two crew member configuration can also be used for combat missions. The F-105G is a modified F-105F designed for Wild Weasel missions. (Refer to T.O. 1F-105G-1A.) The fuselage is an area rule (coke bottle) shape with swept back wings and empennage. Each wing incorporates an aileron, a five-section spoiler, a leading and a trailing edge flap. The flaps provide increased lift while a four-section speed brake and a drag chute, installed in the aft end of the fuselage, provide increased drag. The power plant is a twin spool type turbojet engine equipped with an afterburner and water injection. The tricycle landing gear has a steerable nose wheel. The hydraulically actuated flight controls are equipped with artificial feel devices to simulate aerodynamic feel for the pilot. Some stores can be carried in a fuselage enclosed bomb bay and a greater variety of stores can be carried externally. The stores can be released automatically by the fire control system or manually, using information provided by the fire control system. A high-rate-of-fire gun is installed. The aircraft is equipped for single point ground refueling and air refueling from either a drogue or boom type tanker.

AIRCRAFT DIMENSIONS.

The overall dimensions of the aircraft under normal conditions of gross weight, tire, and strut inflation are as follows:

Length (incl. horizontal control surfaces but not incl. the pilot boom.)	F-105D	F-105F	F-105G
Height to top of seat fin	64 ft 5.3 in.	66 ft 11.8 in.	69 ft 7.3 in.
Height to top of canopy	49 ft 8.4 in.	20 ft 5.6 in.	20 ft 1.9 in.
Wheel Base	42 ft 4.0 in.	41 ft 10.8 in.	41 ft 10.8 in.
Tread	24 ft 1.0 in.	23 ft 8.0 in.	23 ft 8.0 in.
Wing Span		47 ft 3.2 in.	44 ft 11.2 in.
Horizontal Stub Span		17 ft 3.72 in.	

Note

Refer to section II for minimum turning radius and ground clearance dimensions.

AIRCRAFT GROSS WEIGHT.

For average gross weight for planning purposes, refer to Part I of the Appendix. For gross weight limitations refer to section V and for exact aircraft weight refer to the most recently completed copy of T.O. 1-1B-40 for the aircraft to be flown.

AIRCRAFT BLOCK NUMBERS.

Production changes that affect the aircraft and/or its equipment are identified by the addition of a block number to the aircraft designation. Instrument panels and control consoles which are not identical in all aircraft and in which the differences do not affect procedures are shown as a single illustration labelled TYPICAL. No attempt is made to show minor variations in arrangement. Addition and deletion of controls and indicators are indicated by inserts and by notations in the figure key. In cases where production change information is of definite value to the pilot in the operation of the aircraft, a code is used to identify specific paragraphs, illustrations, and procedural steps NOT

USAF Serial NO.	Aircraft Model	Code
58-1151 thru 58-1173 59-1717 thru 59-1757	F-105D-5RE	D 5
59-1758 thru 59-1774 59-1817 thru 59-1826 60-409 thru 60-426	F-105D-6RE	D 6
60-427 thru 60-535 60-5374 thru 60-5385	F-105D-10RE	D 10
61-041 thru 61-106	F-105D-15RE	D 15
61-107 thru 61-161	F-105D-20RE	D 20
61-162 thru 61-220 62-4217 thru 62-4237	F-105D-25RE	D 25
62-4238 thru 62-4276	F-105D-30RE	D 30
58-1150	F-105D-5RE	D 31
62-4277 thru 62-4411	F-105D-31RE	
62-4412 thru 62-4447 63-8260 thru 63-8366	F-105F-1RE	F

MAIN DIFFERENCE TABLE		F-105	
	F-105B	F-105D	F-105F/G
CREW	ONE	ONE	ONE OR TWO
FLIGHT INSTRUMENTS	CONVENTIONAL	INTEGRATED	
FIRE CONTROL SYSTEM	MA-8	AN/ASG-19 (THUNDERSTICK)	
ENGINE	J75-P-19	J75-P-19W	

Figure 1-8

applicable to all aircraft. The code appears at the top right hand corner of paragraphs, in illustrations, or after the titles of illustrations, in the vicinity of an applicable part of an illustration, and in procedural steps.

Differences in aircraft configuration may also be brought about by Modification and Time Compliance Technical Orders. These differences are presented by an abbreviated form of Technical Order number in a bracket followed by N/C/W or C/W for not complied with or complied with. Those Technical Orders that affect operating procedures are listed on the TCTO IDENTIFICATION page in the front of the manual. Operating personnel must be aware of the status of these Technical Orders.

ENGINE.

The aircraft is powered by a Pratt and Whitney, J75-P-19W engine (figure 1-2). Rated sea level static thrust of the uninstalled engine is approximately 16,100 pounds without the afterburner, 24,500 pounds with the afterburner in operation, and 26,500 pounds with afterburner and water injection in operation. The engine is a continuous flow gas turbine incorporating an eight stage low pressure compressor, a seven stage high pressure compressor, an eight unit can annular combustion chamber, a split three stage turbine and an afterburner with a two-position exhaust nozzle. The compressor rotor assemblies are mechanically independent of each other. The high pressure compressor rotor is connected to, and driven by, the first stage turbine wheel by a hollow shaft. A shaft, rotating within the hollow shaft, independently joins the low pressure compressor rotor to the combined second and third stage turbine wheels.

VARIABLE AIR INLET SYSTEM. (VAI)

The variable air inlet (VAI) system is provided to match the inlet airflow to the engine requirements for maximum efficiency through the wide speed range of the aircraft. The system consists primarily of moveable contoured plugs located in the air inlet in each wing root and bleed doors on each side of the fuselage. Both the contoured plugs and the bleed doors are positioned by hydromechanically operated screw jacks, utilizing utility hydraulic system pressure. Plug movement controls the size of the air inlet area and the bleed door opening bypasses (or dumps) excess air. The amount of air flow through the inlet is controlled primarily by the projected frontal area of the lips and the engine airflow demand imposed on the inlets. A VAI switch is provided to select automatic, emergency or cruise operation. In automatic operation during takeoff, subsonic acceleration, climb, or cruise, the plugs remain fixed in the full aft position and the bleed doors closed. On increasing speed, at approximately Mach 1.05 (± 0.05) the VAI system is energized and controlled by signals from the central air data computer (CADC). Refer to figure 1-49 and CADC system. Between Mach 1.05 and 1.5 the bleed doors may open depending on the airspeed and temperature. Above Mach 1.5 the bleed doors start to open regardless of air temperature and the plugs start to move forward, both scheduled by a Mach number signal from the CADC. The plugs will reach their full forward position at approximately Mach 1.92. As the aircraft decelerates the plugs return to the aft position along the same schedule. Automatic operation requires DC primary, AC primary and AC secondary power.

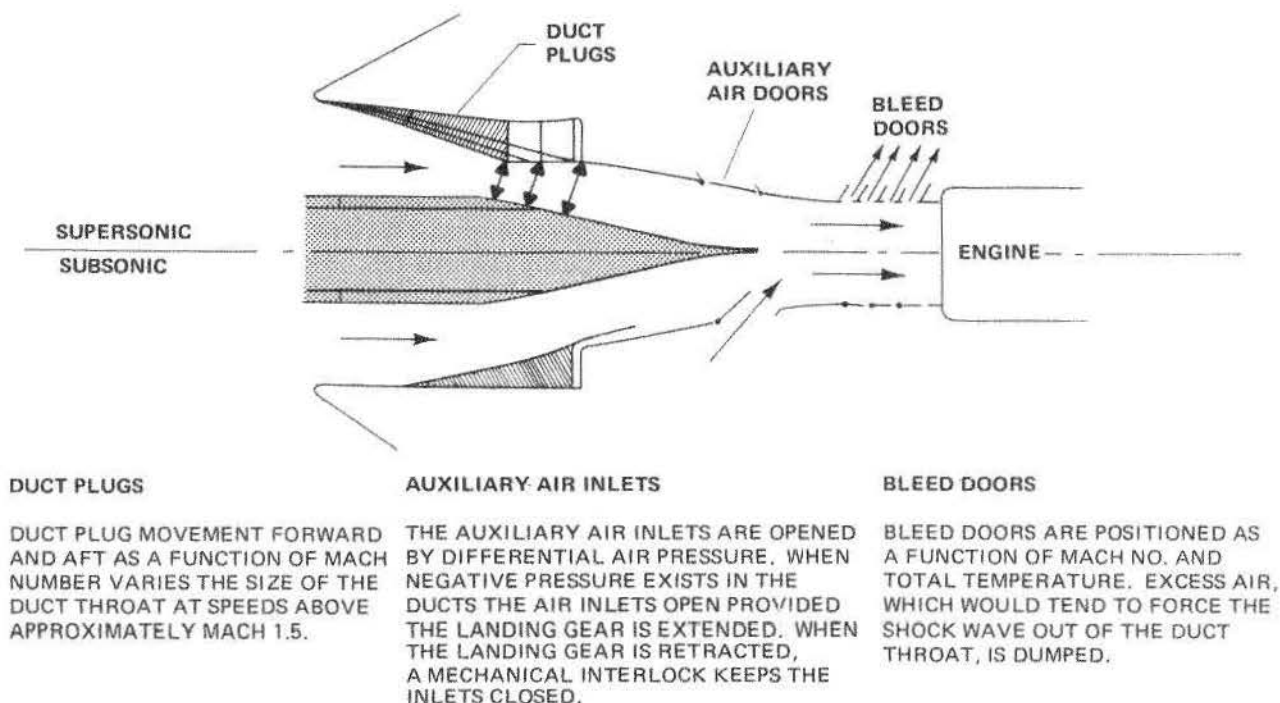


Figure 1-9

CAUTION

At supersonic speeds, the VAI system schedules air flow intake to match the engine airflow demand at maximum thrust to avoid engine compressor stall. For this reason the throttle must be maintained full forward above 1.3 Mach.

Note

If plug operation in each duct is out of synchronization by more than seven percent of total travel, the plug control system will become deenergized and lock the plugs in the last position until corrective maintenance is accomplished.

In emergency operation, the plugs lock in their current position and the bleed doors open. Emergency operation requires power from the DC primary bus. In cruise operation, the plugs move full aft and the bleed doors close. Cruise operation requires DC primary and AC primary power. A subsystem consisting of auxiliary air inlets (sucker

doors) with fixed screens is located on the inboard side of each main landing gear wheel well. These inlets improve engine performance at takeoff by increasing air inlet efficiency and are opened when negative pressure exists in the ducts. During takeoff, the inlets are closed and locked mechanically by the main gear inboard door as it closes following gear retraction.

Note

If VAI system is inoperative, aircraft restrictions as presented in section V must be observed.

Variable Air Inlet Switch (VAI).

The VAI switch (figure 1-28) (not in rear cockpit) placarded VARI AIR INLET is a three-position toggle switch with positions placarded AUTO, EMERG, and CRUISE. In the AUTO position the plugs and bleed door position are automatically controlled by the VAI computer which receives Mach number and temperature signals from the air data computer. The plugs will remain in the cruise position even though the switch is in AUTO until

airspeed exceeds Mach 1.05. Automatic operation requires DC primary, AC primary and AC secondary power. The EMERG position locks the plugs in their present position and opens the bleed doors, and is powered by DC primary power. The CRUISE position moves the plugs full aft and closes the bleed doors, and is powered by DC primary and AC primary power. All plug and door operation is powered by the utility hydraulic system.

Note

The variable air inlet switch cannot be moved from EMERG to CRUISE until it is first lifted and placed in CRUISE. This feature prevents inadvertent movement of the switch from AUTO to CRUISE position during supersonic speed, which may induce a duct buzz condition.

ENGINE FUEL CONTROL SYSTEM.

Fuel flow to the engine is supplied from the aircraft fuel system, controlled by the throttle and regulated by the engine fuel control system (figure 1-10). This system includes the fuel pump unit, fuel control unit, and the afterburner fuel control unit.

Dump Valve.

A dump valve is provided to automatically drain the engine fuel manifold when the engine is stopped. The dump valve automatically closes when the engine is started and remains closed while the engine is running.

Fuel Pump Unit.

The engine driven fuel pump unit (figure 1-10) consists of a common housing which incorporates a fuel transfer valve, a centrifugal boost pump, a single element gear type engine fuel pump, and a dual element gear type afterburner fuel pump. The pumps are mechanically driven by the engine high pressure rotor, and individual shear sections are provided in the drive shafts of each pump so that failure of one pump need not cause failure of the other two. Fuel from all the tanks passes through the centrifugal pump. This provides the required fuel pressure boost to the engine or afterburner pumps for certain flight conditions if the aircraft fuel tank boost pumps fail. The dual element afterburner pump maintains fuel pressure for the afterburner system with one element acting as a standby emergency pump for the engine fuel control unit. If the gear type engine fuel pump output

pressure drops below a differential pressure of 50-75 PSI, the fuel transfer valve automatically ports the output of one element of the afterburner fuel pump to the engine fuel control unit to sustain engine operation up to full military thrust. Military thrust is possible in the event of failure of any one fuel pump; it is also possible in the event of a combination failure of any two fuel pumps with one exception: Flameout will occur if both the engine fuel pump and the one supporting afterburner fuel pump element fail. Afterburner operation is possible, up to 75 percent afterburner thrust on a standard day if any one pump fails. No warning of partial failure of the fuel pump unit is provided for the pilot.

Engine Fuel Control Unit.

A fuel control unit (figure 1-10) incorporates both the normal and emergency fuel control systems and regulates fuel flow to the engine combustion chambers. Engine driven governors adjust fuel flow so that for any given throttle setting, the normal system adjusts fuel flow for altitude changes, schedules fuel flow to protect the engine from overspeed and overtemperature conditions during rapid engine accelerations, and also prevents compressor surge or stall. A burner pressure limiter automatically reduces fuel flow when burner pressure approaches the maximum safe limit of the engine case. During rapid decelerations of the engine, the normal system maintains a minimum fuel flow to prevent engine flameout. A fuel cutoff valve, mechanically connected to the throttle shuts off fuel from the normal or emergency systems, to the engine combustion chambers. A pressure loading valve, incorporated in the engine fuel control unit maintains pressure in the normal or emergency fuel control systems to assure satisfactory operation of either system. The emergency fuel control system provides regulation of engine fuel flow if the normal system fails, and must be manually selected by the pilot as no provisions are made for automatic transfer in the event of failure of the normal fuel control system. During operation on the emergency system, the normal system is inoperative and fuel flow is metered by a throttle valve in the emergency fuel control which is mechanically connected to the throttle.

The emergency fuel system may be used any time failure of the normal fuel control system is suspected. The system may be selected at any RPM or throttle setting; however, it is desirable to position the throttle to IDLE, or if time and altitude permits, match engine RPM indication. Illumination of the EMERG

FUEL SYS ON caution light indicates that the emergency fuel system switch is in the EMER FUEL SYSTEM position and that fuel pressure has transferred fuel flow to the emergency fuel system. When making an airstart, if the caution light is delayed in illuminating, a delay in relight must be anticipated due to the time required to prime the engine driven fuel pump and provide pressure which will transfer the fuel flow from the normal system to the emergency system. When operating on the emergency fuel system, the throttle must be moved slowly (no less than two seconds from IDLE to desired setting) to avoid exceeding RPM and EGT limits. Monitor RPM and EGT and control with throttle. The throttle mechanically positions a valve that meters fuel flow. The emergency system compensates only for changes in engine air inlet pressure and does not incorporate the more complex RPM regulation, acceleration, and deceleration schedules of the normal fuel control system. The system will maintain at least 95 percent military thrust at sea level on a 37.8°C (100°F) day and at least 80 percent military thrust up to 30,000 feet at standard day conditions plus 40°F. The afterburner may be started and operated when operating on the emergency fuel system. RPM and EGT must still be monitored as during emergency operation without afterburner. When the emergency fuel system is selected, ignition is supplied for approximately 20 seconds if the throttle is forward of OFF. Emergency fuel system selection and illumination of the emergency fuel system caution light requires DC primary power.

CAUTION

Since the emergency fuel system does not offer the automatic overspeed, overtemperature, flameout, and compressor stall prevention features of the normal fuel control system, rapid throttle movements shall be avoided during operation of the emergency fuel system.

ENGINE SPEED BIAS VS DROOP.

To compensate for thrust changes brought about by variations in engine inlet temperature and pressure, the fuel control is designed to decrease high pressure compressor rotor RPM with a decrease in inlet temperature and pressure and increase it with an increase in these parameters. This action is called speed bias. It is not normally noticeable except during locked throttle constant Mach climbs

during which the high pressure compressor rotor RPM will decrease approximately two percent RPM. This will occur with no appreciable decrease in EGT. RPM droop is defined as an RPM decrease in which a substantial decrease in EGT also occurs. This condition is considered a malfunction and action should be taken to correct it. In a military thrust climb to altitude, the EGT should not decrease more than 40°C from the value read after afterburner shutdown following takeoff. An EGT loss of 40°C or less constitutes normal speed bias requiring no corrective action.

BURNER PRESSURE LIMITER.

The burner pressure limiter in the engine fuel control unit automatically reduces fuel flow when burner pressure approaches the maximum safe limit, based on engine case strength. Limiter action occurs only at low altitude and produces a slight RPM loss which may be accompanied by an engine surge. This surge, which should not be confused with a compressor stall, is not harmful and can be eliminated by a slight reduction in engine RPM or airspeed. Under extreme cold-weather conditions, limiter action may occur just after takeoff and before initial climb. At outside air temperatures of 60°F and above, the limiter will operate at about Mach 1.0 at sea level.

Afterburner Fuel Control Unit.

The afterburner fuel control unit (figure 1-10) incorporates the afterburner shutoff valve and the fuel control metering valve. When the afterburner is operating, the shutoff valve is opened electrically allowing fuel to flow through the afterburner fuel control unit. When the shutoff valve is closed the total output of the afterburner fuel pump is routed back to the centrifugal boost pump outlet. To prevent overheating fuel and possible vapor lock, a fuel vapor purging system vents the outlet side of the afterburner pump elements to the main fuel tank. When afterburner is selected a normally open solenoid valve is energized by DC primary power and closes the vent, preventing fuel from flowing back to the main tank. The fuel control metering valve automatically meters fuel to the afterburner proportionately to burner pressure.

Throttle.

Engine thrust is controlled by the throttle (figure 1-11) which is mechanically linked to the engine fuel control unit. The throttles in the [E] aircraft are interconnected by cables and any movement of one throttle is duplicated by the other; however

ENGINE FUEL CONTROL SYSTEM

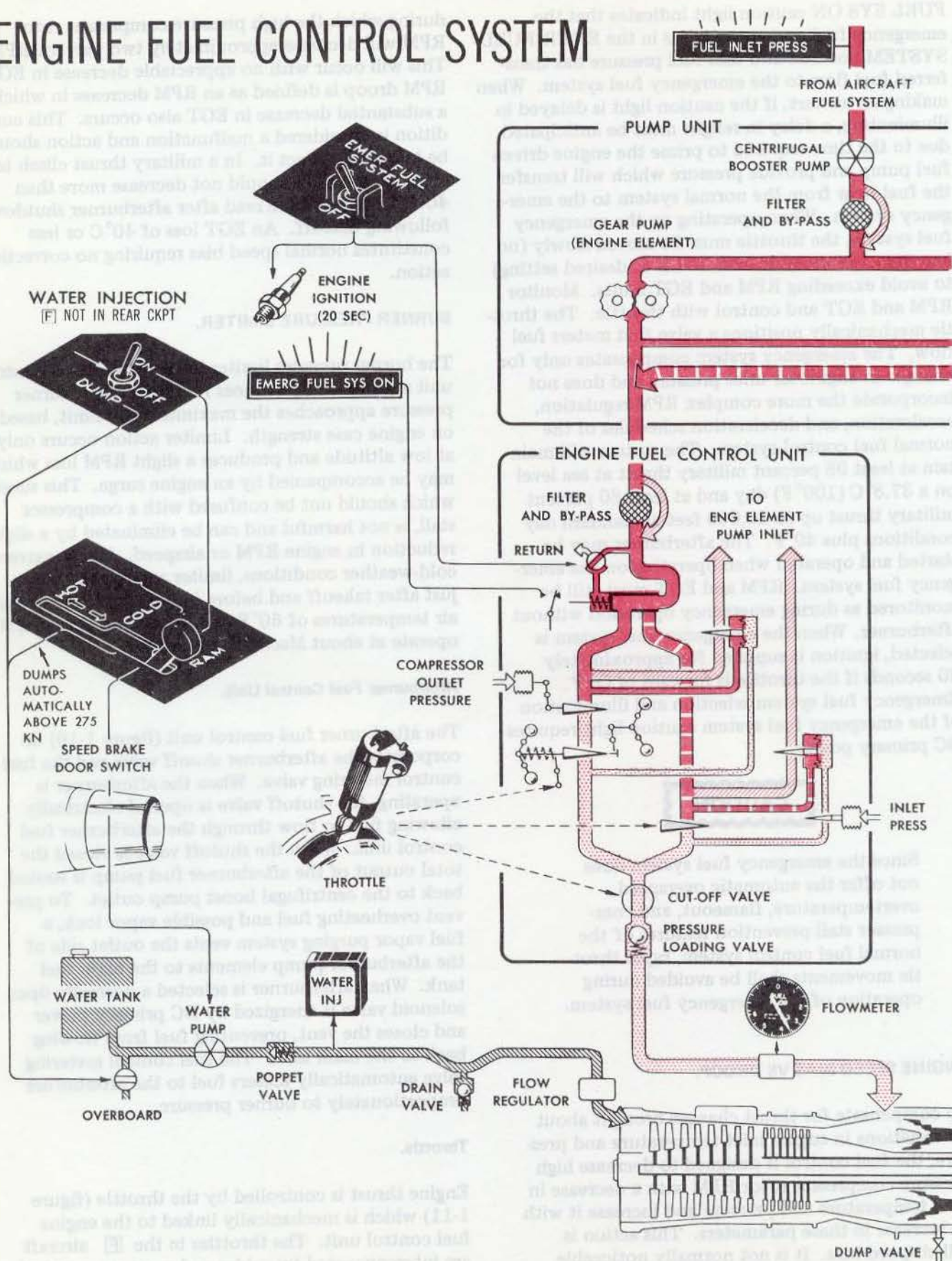


Figure 1-10 (Sheet 1 of 2)

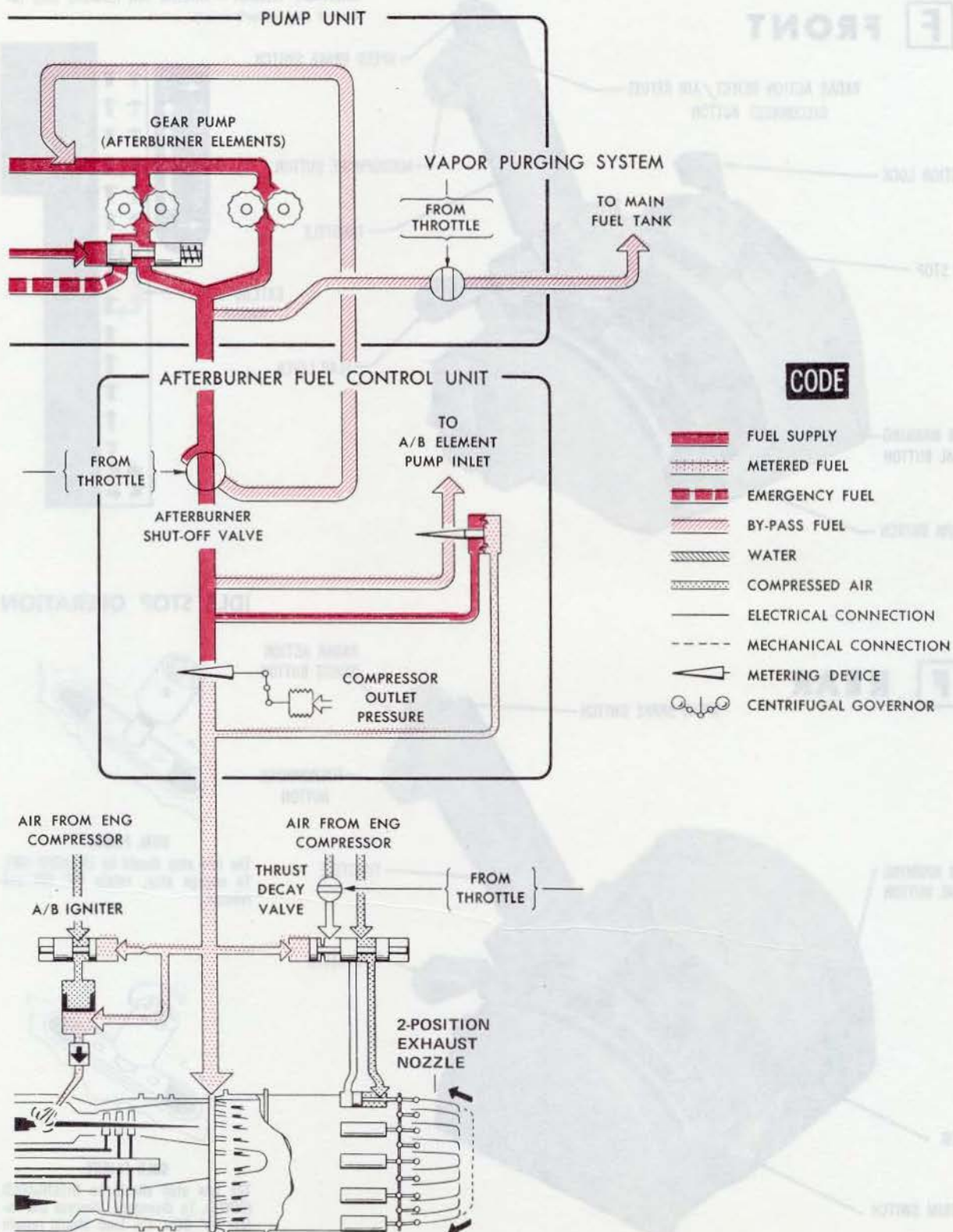
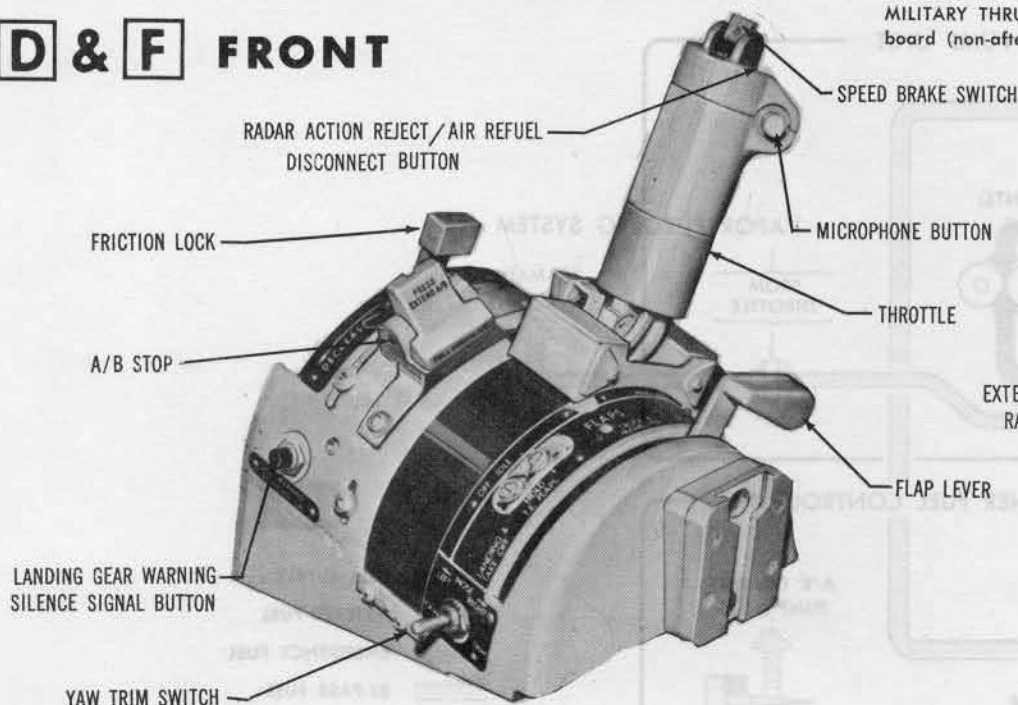


Figure 1-10 (Sheet 2 of 2)

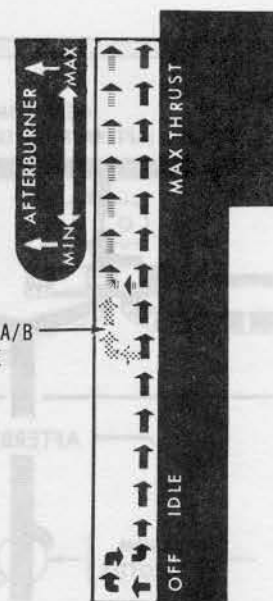
THROTTLE QUADRANT and throttle movements

D & F FRONT

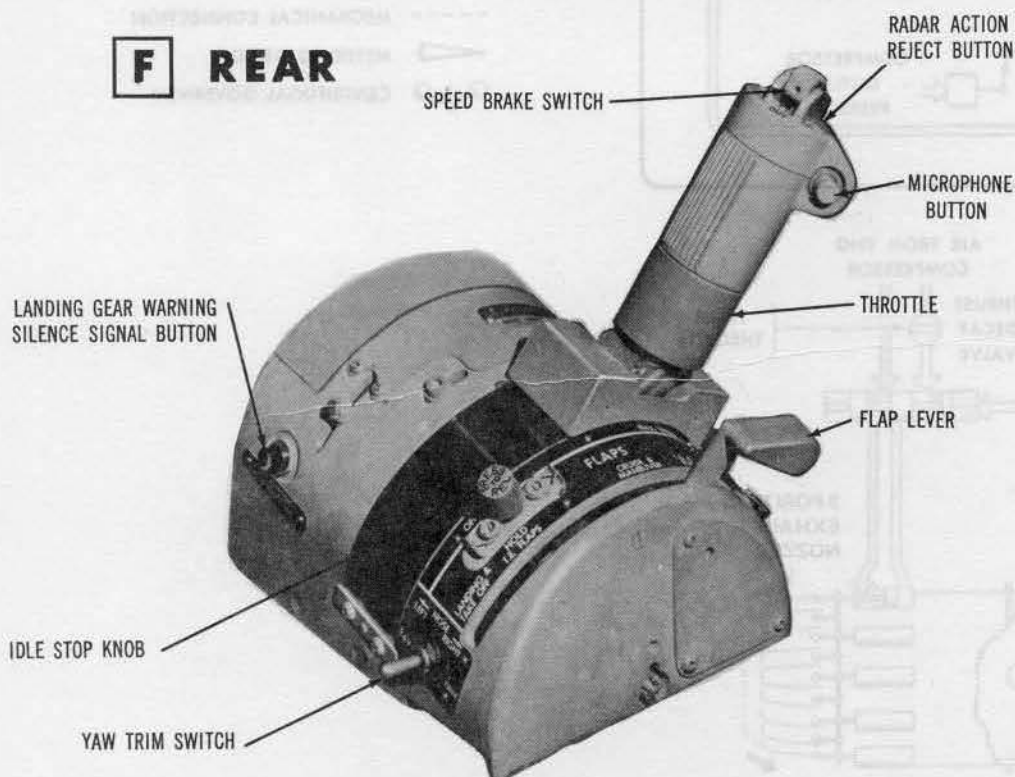


NOTE

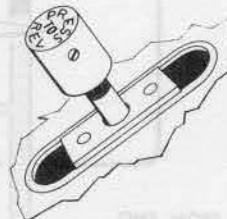
Throughout text and procedures throttle positions are referred to as:
MAXIMUM THRUST — Throttle full forward and outboard (afterburner).
MILITARY THRUST — Throttle full forward and in-board (non-afterburner).



F REAR

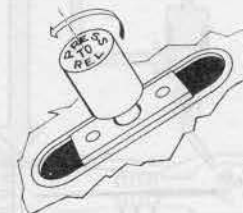


IDLE STOP OPERATION



DUAL FLIGHT

The idle stop should be **ENGAGED (UP)**. To engage stop, rotate 90° CW and release.



SOLO FLIGHT

The idle stop should be **DISENGAGED (DOWN)**. To disengage, depress and rotate 90° CCW, the knob should remain down.

Figure 1-11

each is independent in outboard-inboard travel (afterburner range) and the throttle in the rear cockpit does not have an EXTEND A/B range stop or OFF position. The throttle rotates on two axes. One axis permits forward and aft movements while the other axis permits outboard and inboard movements (afterburner range). If a crew-member in the [F] aircraft has the throttle in afterburner range, the afterburner can be turned off by the other crew-member by retarding the throttle to a point below the minimum afterburner position where a tapered ramp forces the throttle inboard. To stop cock the throttle, retard to IDLE, push outboard, bring it directly back then inboard. Perform the operation in a box like pattern. The OFF position mechanically closes the fuel cutoff valve in the control unit and disarms the engine ignition circuit. The throttle must be moved outboard to pass from OFF to IDLE position. the IDLE position arms the engine ignition circuit and mechanically opens the fuel cutoff valve. Movement of the throttle from IDLE to MAX THRUST position, with the throttle inboard, adjusts the fuel flow for the required engine thrust. Movement of the throttle outboard, between the MIN and MAX AFTERBURNER positions, opens the speed brakes to afterburner position. This completes a circuit to the A/B shutoff valve, permitting fuel flow to the A/B fuel control unit. During NORMAL A/B operation a thrust variation is available, ranging between maximum available thrust and the equivalent of about 50 percent A/B thrust, by advancing or retarding the throttle to vary engine RPM. The thrust variation is due primarily to the change in thrust of the engine as RPM is changed (approximately 6 percent RPM range is available) and the A/B thrust remains relatively constant. The EXTEND A/B range is selected by rotating the EXTEND A/B range stop outboard. The stop is rotated inboard to return to A/B operation to the normal range.

The extend A/B provision is provided so that thrust may be varied during air refueling. In the EXTEND A/B range, a greater thrust variation is available, ranging from the maximum available thrust to approximately the equivalent of military thrust, by advancing or retarding the throttle to vary engine RPM. In this range the thrust variation is due both to the decrease in engine thrust (approximately 20 percent RPM) and a decrease in A/B thrust. In the [F] aircraft the rear cockpit throttle quadrant incorporates an IDLE STOP assembly to prevent engine flameout if the rear pilot snaps the throttle back to IDLE. The idle-stop knob is placarded PRESS TO REL and is spring-loaded upward. When the knob is rotated CW and is in the up position the

idle stop is engaged. The engine may be shut down from the front cockpit, while the idle-stop is engaged, by overcoming approximately 30 pounds of pressure, when the knob is in any other position than full clockwise and up, the idle-stop is disengaged and the engine may be shut down normally from the front cockpit. During the pre-flight check, while flying solo, the knob should be depressed and rotated fully counterclockwise and released into the detent, thereby allowing the forward throttle to be moved from IDLE to OFF without restriction. The throttle is prevented from creeping by tightening the friction lock (not in rear cockpit) on the throttle quadrant. The rear throttle friction is determined by the friction lock of the front throttle. The throttle grip incorporates the speed brake switch, the microphone button, and the radar action reject air refueling disconnect button and rotates on its own axis for radar functions. The throttle quadrant incorporates two dust covers which prevent foreign matter entering the quadrant (metal strips that cover the openings roll into containers on the forward and aft sides of the throttle grip base). Through spring action, the metal strips roll and unroll from the throttle grip during throttle movement. If the dust covers are bent, torn, maladjusted, or if one is missing, the throttle may creep or bind.

WARNING

- [F] If the rear pilot snaps the throttle back to IDLE when the IDLE STOP is disengaged (down) the engine may flameout.

Note

- [F] The rear cockpit throttle cannot be placed in the OFF position and the rear throttle quadrant does not have the EXTEND A/B range stop.
- [D] The throttle has a square stop at minimum afterburner and cannot be taken out of afterburner by pulling straight back on the throttle.
- [F] The throttle with a tapered ramp will come out of afterburner with a straight back pull to a position below minimum afterburner. Pilots unfamiliar with the [F] should be careful not to accidentally come out of afterburner due to the tapered ramp at critical times such as formation takeoff.

EMERGENCY control panel

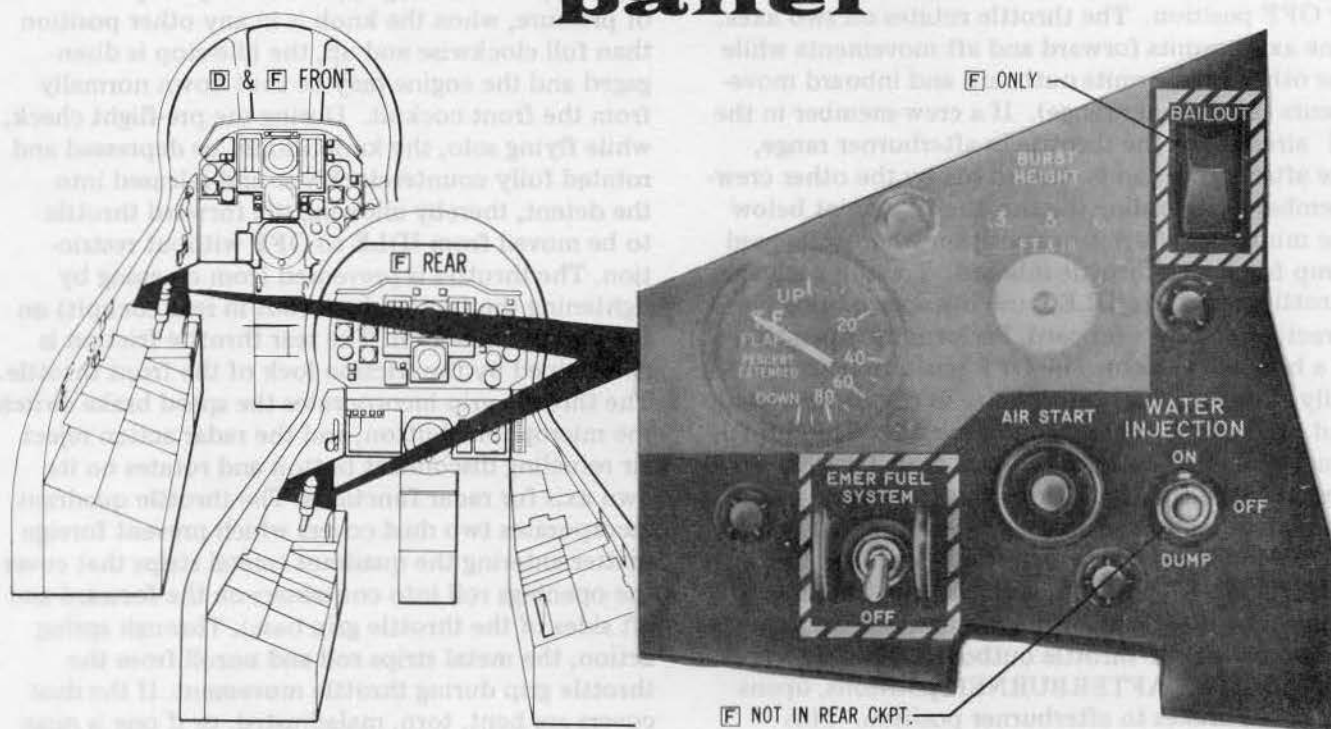


Figure 1-12

Thrust Decay System.

A thrust decay system (figure 1-10) is provided so that a higher engine idle RPM can be used during ground handling without increasing the effective thrust of the engine. The higher idle RPM permits a higher output of the air turbine motor, thereby permitting the AC generator to satisfy AC power requirements. With the weight of the aircraft on both main gears, positioning the throttle to IDLE automatically opens the variable exhaust nozzle to the afterburner position. A DC primary circuit, completed through switches closed by the IDLE position of the throttles, a relay opened by weight on the main landing gear torque links and a relay closed by the landing gear handle being in the DOWN position, energizes and opens a control valve which directs engine compressor air to open the variable exhaust nozzle. A DC secondary circuit completed through switches closed by the main gear torque links when weight is off the gear energizes a relay which breaks the DC primary circuit and disarms the thrust decay system.

CAUTION

The thrust decay system will operate in flight if the DC generator has failed, the

landing gear is extended and the throttle is reduced to IDLE. During the landing approach with the decreased thrust at idle RPM, due to operation of thrust decay, an excessive sink rate may result.

Note

As the throttle is advanced approximately one-half inch from IDLE a slight drop in RPM will indicate the nozzle has closed.

Emergency Fuel System Switch.

The emergency fuel system switch (figure 1-12) is a two-position switch placarded EMER FUEL SYSTEM and OFF. The OFF position energizes a solenoid valve, incorporated in the engine fuel control unit, which allows fuel flow through the normal fuel system. The EMER FUEL SYSTEM position energizes a solenoid valve which allows fuel pressure to move the valve to allow fuel flow through the emergency fuel system and illuminate the emergency fuel system caution light together with the master caution light. The EMER FUEL SYSTEM position also supplies engine ignition for approximately 20 seconds and which may be heard in the headset. The switch is powered by DC primary power. If the DC primary power fails, the solenoid valve will remain in its last selected position.

Emergency Fuel System Caution Light.

The emergency fuel system caution light located on the caution light panel (figure 1-60) displays EMERG FUEL SYS ON and is powered by DC primary power. Illumination of the light indicates that the emergency fuel system switch is in the EMER FUEL SYSTEM position and that fuel pressure has moved the valve fully to the emergency position.

WATER INJECTION SYSTEM.

A water injection system (figure 1-10) is provided for thrust augmentation during afterburner takeoffs from sea level to 8,000 feet in ambient temperatures of 40°F and higher. A 36-gallon tank provides a one minute supply of water, which is pressurized by a hydraulically driven motor powered by the utility hydraulic system and controlled by DC secondary power. A pilot operated switch, (not in rear cockpit) in series with a switch actuated by the speed brake doors, and a switch actuated by the temperature control level, operates a solenoid valve in the utility hydraulic pressure supply line to the hydraulically operated pump motor. Water under pressure from the pump opens a poppet valve, set for approximately 110 PSI, and flows through a tube to a flow regulator and spray ring in the engine. The spray ring is located in the engine air inlet, forward of the first compressor stage. An automatic drain valve at the low point between the poppet valve and the spray ring is closed by water pressure during operation, and opened when pressure is relieved to permit the pressure side of the system to drain. A solenoid valve located at the low point of the supply line to the pump permits the pilot to dump unused water overboard, or automatic dumping when the temperature control level is moved from RAM and speed is above 275 KCAS. Unused water must be dumped for the following reasons:

- The tank is not stressed for high G loads when containing water.
- If the tank becomes distorted from high G loads or freezing, it may bind the rudder control cables.
- If water injection is used during flight with afterburner at altitudes above 8,000 feet and temperatures below 4.4°C (40°F) the engine may flame out.
- If the forward fuel tank is empty, water on board may result in an aft CG condition.

Water Injection Switch.

The water injection switch (figure 1-12), (not in rear cockpit) placarded WATER INJECTION has three placarded positions: ON, DUMP and OFF and is powered by DC secondary power. The ON position turns on the water injection system if the temperature control level is in RAM and the speed brakes are in the A/B position. the DUMP position opens a normally closed solenoid valve, located at the low point of the supply line to the pump, thus permitting the water supply to dump overboard. The OFF position disconnects all electrical power and shuts off the system.

WARNING

Afterburner takeoff with water injection must be accomplished with the temperature control lever in RAM and outboard.

- The water injection switch must be placed in the ON position after light-up of the afterburner to prevent overspeed of the engine low pressure rotor. Afterburner light-up requires approximately 5 seconds. The engine tachometer does not indicate RPM of the low pressure rotor.

Note

Engine flameout may occur during ground operations in IDLE if water injection switch is ON.

Water Injection Indicator Light.

The water injection indicator light (figure 1-60) on the main instrument panel, displays WATER INJ and is powered by DC secondary power. Illumination of the light indicates system operation. A pressure switch located between the poppet valve and the flow regulator completes a circuit when pressure is available. The light is extinguished when the water supply is depleted, the water injection switch is positioned to DUMP or OFF, or the system malfunctions.

ENGINE STARTER AND IGNITION SYSTEM.

The engine is equipped with a breech loading, cartridge-pneumatic type starter. Depressing the cartridge start button provides DC primary power

to ignite the charge in the cartridge. The expanding gases from the burning cartridge turn the starter turbine wheel, which in turn rotates the engine high pressure compressor rotor. Provisions are incorporated for the storage of two starter cartridges in the vicinity of the starter breech. If cartridges are not available, a pneumatic nipple is installed in the aircraft to permit use of externally supplied compressed air to actuate the starter. The engine ignition system is used only during starting, as combustion in the combustion chamber is continuous after the engine has been started. The system consists of two igniter plugs with individual high tension units and a timer. The ignition cycle is initiated when the cartridge or the air start buttons are depressed and continues for 20 seconds after the buttons are released. However, ignition will not be supplied to the engine igniter plugs unless the throttle is out of the OFF position. The emergency fuel switch must be in the OFF position when the cartridge start button is depressed. The afterburner is not provided with an electrical ignition system since light up is accomplished by "hot streak ignition." A squib actuated dump (relief) valve is incorporated in the starter to bypass cartridge gas around the turbine wheel to prevent destruction of the starter in the event of turbine wheel shaft failure and/or turbine overspeed. The squib circuit is armed while the START button is depressed and will fire if the START button is depressed and the overspeed switch in the starter is activated. To prevent inadvertent firing of the squib circuit as a result of starter and/or engine speed, the starter button should be released when the tachometer starts indicating RPM (no more than 10 percent). If the squibs are fired the starter must be replaced.

Cartridge Start Button.

The cartridge start button (4, figure 1-7) (not in rear cockpit) is a momentary contact, pushbutton type switch placarded ENGINE CARTRIDGE START. With DC primary power available, depressing the button energizes the starting circuit and arms the starter relief valve squib circuit. The cartridge in the starter will fire and actuate the starter. The engine ignition timer will operate as soon as the start button is depressed and for approximately 20 seconds after the button is released. Ignition will not be supplied to the engine ignition plugs unless the throttle is out of the OFF position and the emergency fuel switch is OFF.

CAUTION

The cartridge start button will not supply ignition with the emergency fuel switch ON, however, the cartridge will fire.

Air Start Buttons.

The air start button (figure 1-12) is a guarded, momentary contact, pushbutton, type switch placarded AIR START. The button is used to start the engine when it is windmilling in flight, or when making a ground start with externally supplied air. With DC primary power energized, momentarily depressing the button operates the engine ignition timer for approximately 20 seconds after the release of the button; however, ignition will not be supplied to the engine ignition plugs unless the throttle is out of the OFF position.

ENGINE INSTRUMENTS.

Pressure Ratio Gage.

The pressure ratio gage (10, figure 1-3) indicates the ratio of engine turbine discharge pressure to compressor inlet total pressure. The gage is used to determine if engine thrust output on the ground is acceptable for takeoff. The engine compressor section consists of an eight-stage low pressure compressor and a seven-stage high pressure compressor. The rotor assemblies in each compressor section are mechanically independent and therefore do not rotate at the same RPM. The tachometer indicates the RPM of the high pressure compressor rotor only. During the engine manufacturer's calibration run of the engine, high pressure rotor RPM necessary for Military Rated Thrust is determined for an outside temperature of 59°F, and this speed is listed on the engine records. Engine performance usually deteriorates as engine operating time is accumulated, and engine speed must be progressively increased above the original "trim setting" to restore Military Rated Thrust. Therefore, the tachometer provides only an approximate indication of engine thrust. Each engine must be treated individually with respect to the RPM at which Military Thrust is obtained. Because of the maximum speed variations between engines and the inherent inaccuracies of tachometers, the engine is trimmed and power checked

according to turbine discharge pressure, which does not vary as much with thrust as does RPM. A one percent variation in RPM will result in approximately five percent variation in thrust at the higher thrust settings, while a one percent variation in turbine discharge pressure results in approximately one and one-half percent variations in thrust. The pressure ratio gage gives a more accurate indication of take-off thrust than the tachometer or exhaust gas temperature gage. The desired pressure ratio gage reading at Military Thrust depends upon outside air temperature, therefore, the gage must be adjusted just before takeoff to compensate for air temperature. Since engine pressure ratio is not used in the performance data presented in the Appendix, the engine pressure ratio gage is not used during flight. However, if RPM drops off due to an engine malfunction, the pressure ratio and exhaust gas temperature gages will also drop off. If the pressure ratio drops at RPM and EGT remain constant, it can be assumed that the malfunction is in the pressure ratio gage system. The ratio is shown by a conventional indicating dial pointer. Two windows in the dial face show recommended takeoff pressure ratio and cruise pressure ratio. The ratios that appear in the windows are adjustable and are set by an adjusting knob at the lower left corner of the instrument dial. The takeoff pressure ratio is adjusted as part of the preflight check by pushing in and turning the adjusting knob until the ratio that appears in the lower window agrees with the ratio specified in the pressure ratio gage setting table (figure 2-6). When using the pressure ratio gage to check thrust before takeoff, the indicating pointer should fall within the limits of the takeoff index marker on the outer circumference of the gage. This marker is automatically set when making the pressure ratio adjustment in the takeoff window. The cruise pressure ratio setting is not used. The pressure ratio gage system uses single phase 115-volt AC secondary power. If this source of power fails, the gage becomes inoperative, and the indicating pointer will remain at the setting prevailing at the time of electrical power failure.

Exhaust Gas Temperature Gage. ☐

The exhaust gas temperature gage (12, figure 1-3) indicates exhaust gas temperature in degrees Centigrade. Gage indications are received from thermocouples mounted directly downstream of the third stage turbine. The gage displays temperature in 20-degree increments from 0 to 1000. The temperature indicator system is of the self-generating type and is therefore independent of the aircraft electrical system.

PRESSURE RATIO gage



Figure 1-13

Jet Engine Analyzer [D-691], [F-528] or [F-538] C/W.

On aircraft [D-691], [F-528], or [F-538] C/W, an inflight jet engine analyzer (12, figure 1-3) has been installed to indicate that record EGT and engine hot section factor units. The system includes an EGT gage(s) with a digital readout and an engine hot section recorder and computer located in ☐ canopy actuator well and ☐ turtledeck of the aircraft. Temperatures are measured by thermocouples located in the tailpipe aft of the last stage of the turbine. The gage(s) indicates average temperature from all the thermocouples and a warning light on the gage(s) will illuminate at $660^{\circ} \pm 3^{\circ} \text{C}$ to indicate when an over temperature condition occurs. An OFF flag on the gage(s) will appear when electrical power fails. The engine hot section recorder and computer provides a record of time at which the engine has operated above 575°C and 635°C , two over temperature flags set at 725°C and 800°C and a record of hot section factor units. The system is powered by AC primary and DC secondary power.

Tachometer.

The tachometer (9, figure 1-3) mounted on the instrument panel indicates engine speed in percentage of the high pressure compressor rotor, based on 8732 RPM as 100 percent RPM. Maximum observable speed is based on 9300 RPM. The tachometer

receives its power from a generator geared to the engine accessory section and driven by the high pressure compressor rotor. The instrument is therefore independent of the aircraft electrical system.

Note

The thrust characteristics of a "twin spool" engine are such that the RPM setting, at which rated thrust is developed, varies between engines. The exact RPM at which a particular engine obtains its Military Thrust is listed on the "engine records" (this value is specified for a 59° F day, and must be plotted for other temperatures). Engine performance usually deteriorates as engine operating time is accumulated, and engine speed must be progressively increased above the original "trim setting" to restore Military Thrust. Therefore, the tachometer provides only an approximate indication of engine thrust.

Oil Pressure Gage.

The oil pressure gage (11, figure 1-3), powered by single-phase, 26-volt AC primary power, is placarded PSI OIL PRESS and indicates pressure of the oil being furnished to moving engine parts in pounds per square inch. If the AC primary power should fail or the HYD UT/OIL PRESS fuse (2, figure 1-6) should blow, the pressure gage may continue to indicate the same pressure reading that was on the gage at the time of power loss or the reading may go to zero or stop at some intermediate position. One noticeable indication that will appear after AC power loss, is that the normal fluctuation that occurs in the oil pressure system, due to action of the pressure relief valve, will no longer be observed on the gage.

Oil Low Pressure Caution Light.

The caution light (figure 1-60), located on the caution light panel, displays OIL LOW PRESS and is powered by DC primary power. Illumination of the light indicates low oil pressure, but not necessarily below the oil pressure limits presented in section V. The tolerance of the oil pressure gage has been added to the tolerance of the caution light pressure switch in order to maintain realistic check limits. These check limits are as follows:

- On increasing oil pressure, the caution light will go out between 28 and 45 PSI.

- On decreasing oil pressure, the caution light will go on between 39 and 23 PSI.

Note

It is a normal characteristic, that on decreasing pressure, the light will come on at a lower value than that at which it will go out when pressure is increased.

Fuel Flow Indicator.

The fuel flow indicator (13, figure 1-3) registers the rate of fuel flow to the engine in pounds per hour. Indications shown are measured by a transmitter located in the fuel line downstream of the fuel cutoff valve. All fuel entering the engine from the normal or emergency fuel systems passes through the transmitter. The indicator is calibrated to show the rate of flow from 0 to 24,000 pounds per hour. The indicating system is powered by single phase 26-volt AC primary power.

Note

The instrument does not register fuel flowing through the afterburner fuel systems; however, as a rule of thumb, total fuel flow with A/B operating may be estimated at four times fuel flow indicator reading. At near maximum speed, fuel flow may increase up to five times indicator reading.

AFTERBURNER.

The afterburner (A/B) system augments the thrust of the engine by injecting fuel into the afterburner section of the engine, where it is mixed with air and burned, thereby producing approximately 50 percent additional thrust. Because of its high fuel consumption, the system is intended to be used for short operational periods such as during takeoff and critical climb or flight conditions. Operation of the afterburner system is controlled by the throttle. When the throttle is moved outboard within the MIN, and MAX AFTERBURNER range, the afterburner ejector position valve is deenergized. This directs utility hydraulic pressure to open the speed brake doors to the afterburner position (approximately 9 degrees open). When the speed brake doors reach the afterburner position, the ejector sequence switch is actuated which energizes and opens the afterburner shutoff valve, thereby supplying fuel to the afterburner fuel control unit. The fuel control metering valve automatically meters fuel

to the afterburner proportional to burner pressure. Afterburner fuel pressure (augmented by engine compressor air above 5,000 feet) indexes the exhaust nozzle control unit which directs air from the high pressure compressor to actuators which open the two position segmented iris type variable exhaust nozzle at the end of the tailpipe. The afterburner is then ignited at the proper time.

AFTERBURNER LIMITS.

A/B light should not exceed 5 seconds at or below 5000 feet and 8 seconds at 35,000 feet after throttle movement to the A/B range. Light time between 5000 and 35,000 feet will be between 5 and 8 seconds. If A/B does not light at 35,000 to 37,000 feet a second attempt to light is permissible. The maximum A/B ignition altitude is 37,000 feet. Inconsistent lights can be expected above 37,000 feet. Below 25,000 feet altitude the exhaust nozzle opens before afterburner ignition takes place, while above 25,000 feet altitude the exhaust nozzle opens after afterburner ignition takes place. A/B operation is satisfactory (no blow-out) in normal A/B throughout the speed and altitude envelope of the aircraft. Extended A/B operation is satisfactory if confined to air refueling speeds between 15,000 and 38,000 feet altitude. There is no direct mechanical linkage between the throttle and the afterburner fuel metering valve; however, afterburner thrust can be varied up to 50 percent by movement of the throttle between the minimum and maximum afterburner positions except at speed above Mach 1.3 where throttle must be maintained in the full forward position to avoid engine and duct instability. EXTEND A/B range is selected by rotating the A/B stop outboard. To return A/B stop to normal range the A/B stop is rotated inboard. Movement of the throttle inboard closes the afterburner shutoff valve and fuel pressure is no longer supplied to the exhaust nozzle control unit. The valve in the control unit is then positioned to direct engine compressor air to close the variable exhaust nozzle, returning the engine to normal operation. Since afterburner operation is dependent on the speed brakes opening to the afterburner position, it, therefore, is also dependent on utility hydraulic system pressure. DC primary electrical power is required for starting the afterburner. The afterburner speed brake system is provided with an interlock which prevents closure of the speed brakes when the nozzle is open.

CAUTION

If the utility hydraulic system fails, afterburner operation may not be

possible since the speed brakes may not open or hold in the afterburner position.

- The afterburner can be used with the engine operating on the emergency fuel control system. However, throttle movement must be made cautiously to prevent engine overspeed and over-temperature.

AFTERBURNER IGNITER.

When the afterburner system is actuated, fuel from the afterburner fuel unit is directed to the igniter unit (figure 1-10), which injects an additional amount of fuel into one burner of the engine combustion section, thereby creating a local excessively rich fuel air mixture. The excess fuel forms a longer flame which continues to burn past the turbines, and provides "hot streak ignition" for the fuel being discharged from the afterburner nozzles. The igniter is actuated only after fuel pressure is built up within the afterburner manifold. No repeater mechanism is incorporated in the igniter, and the unit does not recycle until afterburner operation is terminated by moving the throttle inboard.

OIL SUPPLY SYSTEM.

The dry sump, recirculating, pressure type engine oil system is supplied from a 5.5 U.S. gallon tank mounted on the left-hand side of the engine compressor section. Usable oil supply is 4.5 gallons. Oil flows from the tank to an engine driven gear type boost pump which pumps the oil through a fuel oil cooler. From the fuel oil cooler the oil flows to the main oil pump. From the main oil pump the oil flows through a main oil strainer which is equipped with a bypass valve for operation in the event of clogging. A relief valve downstream of the oil strainer prevents excessive pressure. From the main oil strainer the oil flows to the main engine bearings and accessory drives. A scavenging system returns oil from the bearing compartments and accessories to the oil tank. A breather system connects the individual bearing compartments and the oil tank with a breather pressurizing valve. A ground service engine oil gage and the required oil grade and specification are presented in the servicing diagram, figure 1-78.

CAUTION

The oil system is not capable of sustaining oil pressure during inverted flight.

FUEL SUPPLY SYSTEM.

The aircraft fuel system (figure 1-14) consists of three bladder type tanks (forward, main and aft) permanently installed in the fuselage. Up to four auxiliary fuel tanks may also be installed. The auxiliary tanks consist of a nonjettisonable tank installed in the bomb bay, an external fuselage centerline pylon mounted tank, and a pylon mounted tank under each wing. On aircraft [1059] C/W, the forward, main and aft tanks are replaced with self sealing type tanks. On aircraft [1058] C/W, the forward, main, aft and bomb bay tanks are filled with polyurethane filler to reduce sloshing of the fuel and increase the crash resistance characteristics of the fuel tanks. A fuel quantity indicating system indicates the quantity of fuel in the various tanks and caution lights provide indications of malfunctions. A fuel manifold, connected to all tanks, permits single point ground refueling or air refueling of all tanks. During refueling as each internal tank fills, a float operated shutoff valve in the tank closes and shuts off the flow of fuel into the tank. As each auxiliary tank fills, a float operated switch activates and deenergizes a solenoid valve which opens and directs fuel pressure to close the shutoff valve and stop the flow of fuel into the tank. When the pilot selects auxiliary fuel, pressurized air, bled from the engine compressor is directed to the selected tank. The pressurized air forces the fuel from the tank through the fuel manifold to the internal tanks. As each internal tank fills, the float operated shutoff valve in the tank closes and shuts off the flow of fuel into the tank. When the tank level drops approximately 20 pounds the auxiliary fuel flow will resume. This cycle will continue to maintain the three internal tanks full until the selected auxiliary tank is emptied. DC primary power is required for all functions of the fuel system except:

- Boost pump caution lights and fuel low caution light — DC secondary power.
- Excess fuel vent caution light — DC secondary power.
- Fuel quantity indication — AC primary power.
- All boost pumps and [F] CG pump — AC secondary power.

Fuel from the main tank is pumped directly to the engine fuel control by the main tank boost pump.

When the main tank level drops to approximately 1400 pounds fuel transfer from the forward and aft tanks begins and continues until the level in the main tank reaches approximately 1600 pounds. This cycle will continue until the forward and aft tanks are empty. A CG pump is provided in the forward tank of the [F] aircraft which transfers fuel, through a refueling line, to the main tank. The pump automatically transfers 1050 pounds of fuel from the forward to the main tank, then shuts off. This will assure a proper CG under certain flight conditions. If the main tank boost pump fails, the reduced pressure at the pump outlet permits a spring loaded bypass valve to open a port which allows the forward and aft tanks to pump fuel directly to the engine. When the forward and aft tanks are empty, the main tank fuel will gravity flow to the engine. If the forward or aft tank boost pumps become inoperative, the respective tank will discontinue transferring fuel until the tanks with operative pumps are empty. At this time the remaining fuel will gravity flow to the engine. If all boost pumps become inoperative, as in the case of an AC generator failure, all internal fuel will gravity flow to the engine, assisted by suction from the engine driven pump. When the fuel level in the main tank is below approximately 1100 pounds, [-1058 and -1059] N/C/W, 1000 pounds [1058 and 1059] C/W the low level caution light will illuminate. If the pilot has inadvertently failed to transfer bomb bay tank fuel and the fuel tank selector switch is in MAIN TK (MAIN), bomb bay tank fuel will transfer automatically when the main tank drops to approximately 1100 (1000) pounds. At the beginning of this automatic transfer the low level caution light may illuminate momentarily and go out when the fuel level rises and opens the float switch; however, fuel transfer from the bomb bay tank will continue until it is empty or the fuel tank selector switch is rotated to EXT WG TK (WING) or BELLY TK (BELLY) position. Automatic bomb bay transfer can also be discontinued by rotating the fuel tank selector switch to the BB TK (BOMB BAY) position, then returning it to the MAIN TK (MAIN) position, provided the low level switch has opened. Although the FUEL LOW caution light and the fuel transfer relay switches are on the same float, minor tolerance differences may cause the FUEL LOW caution light to illuminate before the fuel transfer relay closes or the fuel transfer relay may close before the FUEL LOW caution light illuminates. The fuel tank vent system for the internal tanks and the vent system for the bomb bay and centerline tank are vented overboard through an outlet (Sabre Drain) located on the left side of the aft fuselage. The bomb bay tank vent system incorporates a solenoid operated shutoff valve in the vent line that closes when the

AIRCRAFT FUEL SYSTEM [997C, 1044 and 1061] N/C/W

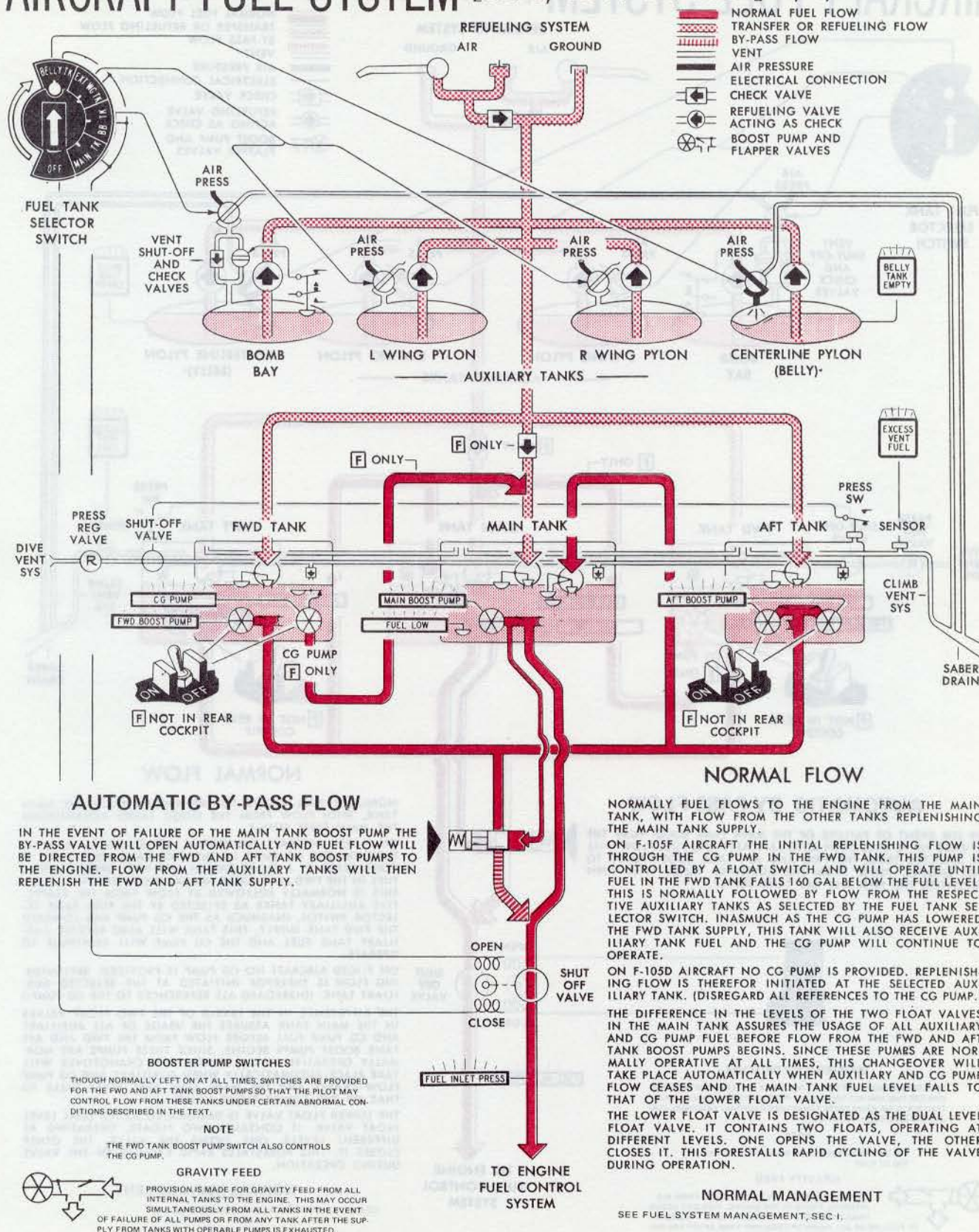


Figure 1-14 (Sheet 1 of 3)

AIRCRAFT FUEL SYSTEM [997C or 1044] C/W [1061] N/C/W

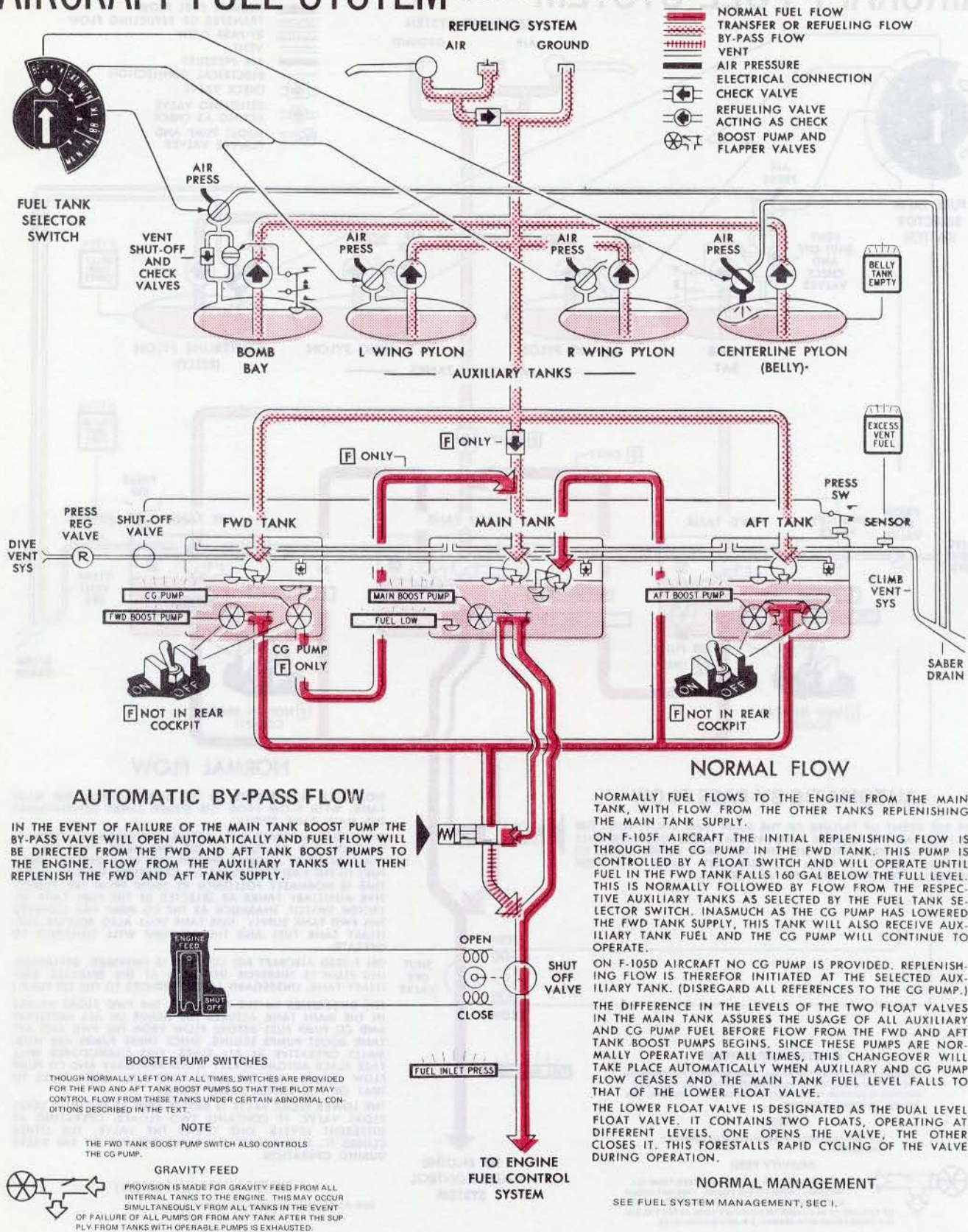


Figure 1-14 (Sheet 2 of 3)

AIRCRAFT FUEL SYSTEM [1044 and 1061] C/W

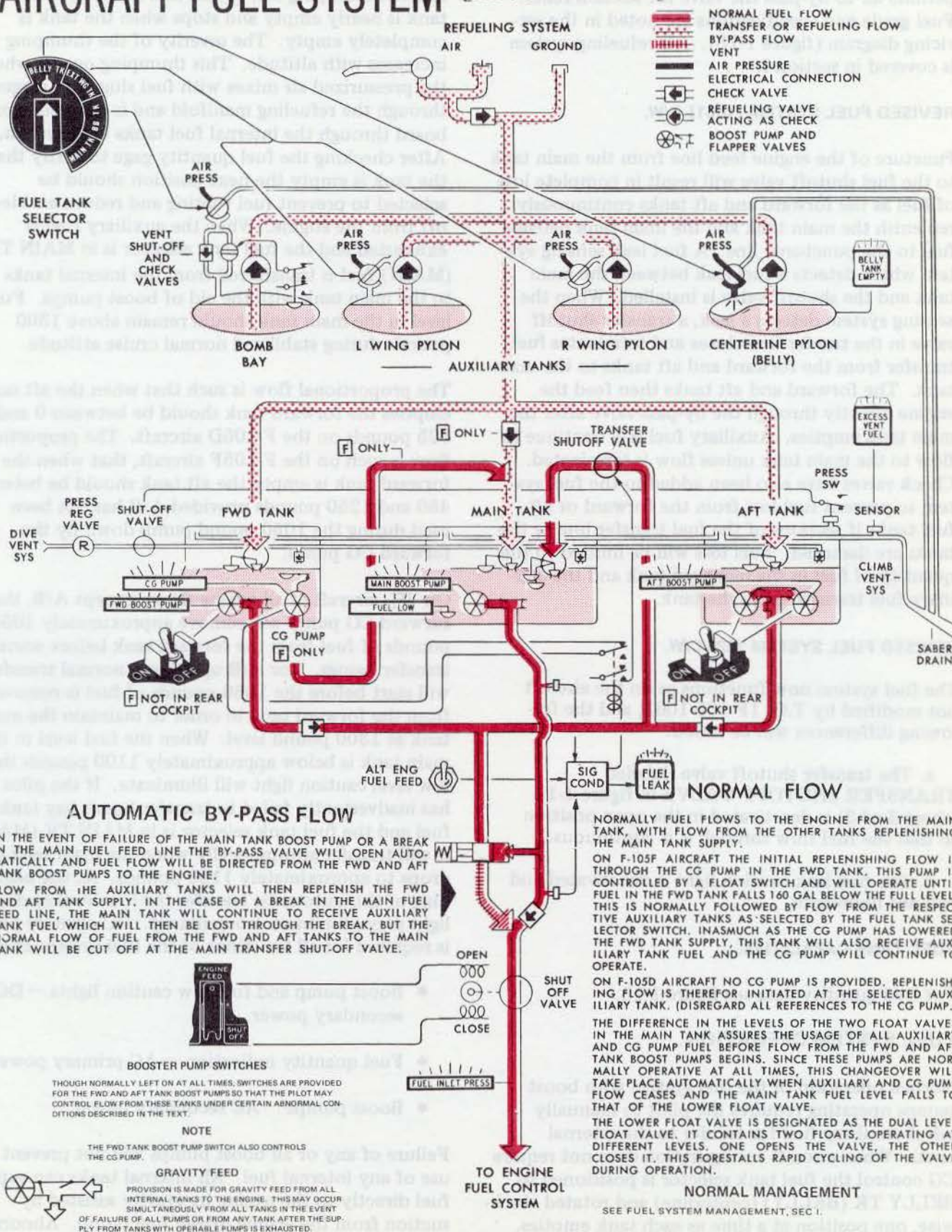


Figure 1-14 (Sheet 3 of 3)

fuel level approaches the vent outlet. A check valve permits air to by-pass the valve for suction relief. Fuel grade and specifications are noted in the servicing diagram (figure 1-78). Air refueling system is covered in section I.

REVISED FUEL SYSTEM [1061] C/W.

Puncture of the engine feed line from the main tank to the fuel shutoff valve will result in complete loss of fuel as the forward and aft tanks continuously replenish the main tank and the main tank delivers fuel to the punctured line. A fuel leak sensing system which detects a fuel leak between the main tank and the shutoff valve is installed. When the sensing system detects a leak, a transfer shutoff valve in the transfer line closes and terminates fuel transfer from the forward and aft tanks to the main tank. The forward and aft tanks then feed the engine directly through the by-pass valve after the main tank empties. Auxiliary fuel will continue to flow to the main tank unless flow is terminated. Check valves have also been added to the fuel system to prevent fuel loss from the forward or aft fuel tanks if sections of the fuel transfer line or the tanks are damaged. Fuel loss will be limited to the quantity of fuel in the damaged tank and the auxiliary fuel transferred to the tank.

REVISED FUEL SYSTEM 1020 C/W.

The fuel system now functions as on the aircraft not modified by T.O. 1F-105-1061, and the following differences will be noted:

- a. The transfer shutoff valve (labeled TRANSFER SHUTOFF VALVE in figure 1-14 (sheet 3 of 3) is deactivated in the open position so that the fuel flow through it is continuous.
- b. The fuel leak caution light is deactivated and will not illuminate.

FUEL TANK CAPACITIES.

For fuel quantity data see figure 1-15.

FUEL SYSTEM OPERATION.

Normal operation of the fuel system with boost pumps operating requires the pilot to manually select auxiliary fuel for transfer to the internal tanks. When aircraft configuration does not require CG control the fuel tank selector is positioned to BELLY TK (BELLY) (centerline) and rotated clockwise, one position at a time as each tank empties, except takeoff is made with the fuel selector in the

MAIN TK (MAIN) position. A pronounced intermittent thumping can be felt and heard as each tank is nearly empty and stops when the tank is completely empty. The severity of the thumping increases with altitude. This thumping occurs when the pressurized air mixes with fuel slugs and surges through the refueling manifold and is relieved overboard through the internal fuel tanks vent system. After checking the fuel quantity gage to verify that the tank is empty the next position should be selected to prevent fuel venting and reduce air bleed off from the engine. When the auxiliary fuel is exhausted and the fuel tank selector is in MAIN TK (MAIN) fuel is transferred from the internal tanks to the main tank with the aid of boost pumps. Fuel level in the main tank should remain above 1300 pounds during stabilized normal cruise attitude.

The proportional flow is such that when the aft tank empties the forward tank should be between 0 and 825 pounds on the F-105D aircraft. The proportional flow is such on the F-105F aircraft, that when the forward tank is empty the aft tank should be between 450 and 1250 pounds provided A/B has not been used during the 1050 pound pump down by the forward CG pump.

On [F] aircraft at all engine flows, except A/B, the forward CG pump will remove approximately 1050 pounds of fuel from the forward tank before normal transfer beings. For A/B operation, normal transfer will start before the 1050 pounds of fuel is removed from the forward tank in order to maintain the main tank at 1300 pound level. When the fuel level in the main tank is below approximately 1100 pounds the low level caution light will illuminate. If the pilot has inadvertently failed to transfer bomb bay tank fuel and the fuel tank selector is in MAIN TK (MAIN), it will transfer automatically when the main tank level drops to approximately 1100 pounds. At the beginning of this automatic transfer the low level caution light may illuminate momentarily. DC primary power is required for all functions of the fuel system except:

- Boost pump and fuel low caution lights -- DC secondary power.
- Fuel quantity indication -- AC primary power.
- Boost pumps -- AC secondary power.

Failure of any or all boost pumps will not prevent use of any internal fuel. All internal tanks can supply fuel directly to the engine by gravity assisted by suction from the engine driven fuel pump. Abnormal internal fuel distribution caused by inoperative boost

pumps (or improper management) may result in exceeding the forward or aft CG limits. Internal fuel distribution may be controlled by shutting off the forward or aft boost pumps as required. If the aft CG is exceeded, extreme caution should be exercised during landing.

NORMAL AUXILIARY FUEL TRANSFER.

1. Fuel tank selector -- BELLY TK (BELLY) until empty (if installed) CG will move aft.
2. Fuel tank selector -- EXT WG TK (WING) until empty (if installed) CG will move forward.

FUEL QUANTITY

data

[—1058 and —1059] N/C/W
DATA DATE: MAY 1963

DATA BASIS: CALIBRATED

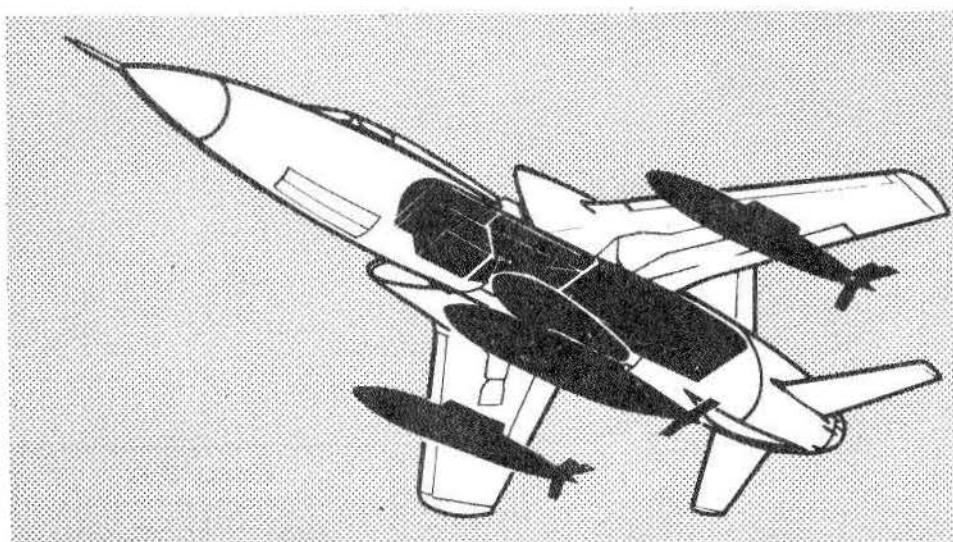
		U.S. GALLONS AND POUNDS			
		USABLE FUEL		FULLY SERVICED**	
		GALS	POUNDS	GALS	POUNDS
CENTERLINE PYLON	450 GAL TANK	450.0	2925.0	452.5	2941.0
	650 GAL TANK	650.0	4225.0	653.0	4244.5
	LEFT INBOARD PYLON TANK	450.0	2925.0	452.5	2941.0
	RIGHT INBOARD PYLON TANK	450.0	2925.0	452.5	2941.0
	BOMB BAY TANK	390.0	2535.0	391.0	2541.5
	MAIN TANK*	1135.0	7377.5	1148.0	7462.0
	FUEL IN LINES	25.0	162.5	25.0	162.5
	FWD TANK	376.0	2444.0	380.0	2470.0
	MAIN TANK	257.0	1670.5	260.0	1690.0
	AFT TANK	502.0	3263.0	508.0	3302.0

[997C and 1044] N/C/W



[997C or 1044] C/W

*MAIN TANK FUEL IS OBTAINED FROM THREE INTERNAL TANKS
**FULLY SERVICED = USABLE FUEL PLUS UNUSABLE FUEL



	USABLE FUEL	
	GALS	POUNDS
MAXIMUM INTERNAL FUEL WITHOUT BOMB BAY TANK	1160.0	7540.0
MAX INT FUEL WITH B/B TANK AND TWO 450 GAL EXT TANKS	2450.0	15925.0
MAX INT FUEL WITH B/B TANK AND THREE 450 GAL EXT TANKS	2900.0	18850.0
MAX INT FUEL WITH B/B TANK AND TWO 450 AND ONE 650 EXT TANKS	3100.0	20150.0

Figure 1-15 (Sheet 1 of 2)

FUEL QUANTITY

data

[-1058 and -1059] C/W

DATA DATE: MAY 1968

DATA BASIS: CALIBRATED

		USABLE FUEL		FULLY SERVICED**	
		GALS	POUNDS	GALS	POUNDS
CENTERLINE PYLON	450 GAL TANK	450.0	2925.0	452.5	2941.0
	650 GAL TANK	650.0	4225.0	653.0	4244.5
	LEFT INBOARD PYLON TANK	450.0	2925.0	452.5	2941.0
	RIGHT INBOARD PYLON TANK	450.0	2925.0	452.5	2941.0
	BOMB BAY TANK	375.0	2437.5	380.0	2470.0
	MAIN TANK*	1026.0	6669.0	1074.0	6981.0
	FUEL IN LINES	25.0	162.5	25.0	162.5
	FWD TANK	334.0	2171.0	348.0	2262.0
	MAIN TANK	242.0	1573.0	254.0	1651.0
	AFT TANK	450.0	2925.0	472.0	3068.0

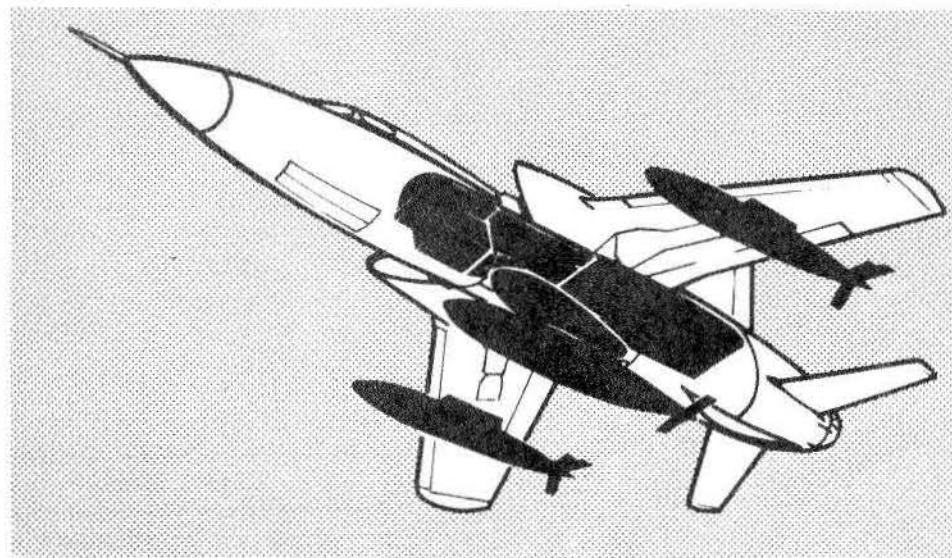
*MAIN TANK FUEL IS OBTAINED FROM THREE INTERNAL TANKS

**FULLY SERVICED = USABLE FUEL PLUS UNUSABLE FUEL

[997C and 1044] N/C/W



[997C or 1044] C/W



	USABLE FUEL	
	GALS	POUNDS
MAXIMUM INTERNAL FUEL WITHOUT BOMB BAY TANK	1051.0	6831.5
MAX INT FUEL WITH B/B TANK AND TWO 450 GAL EXT TANKS	2326.0	15119.0
MAX INT FUEL WITH B/B TANK AND THREE 450 GAL EXT TANKS	2776.0	18044.0
MAX INT FUEL WITH B/B TANK AND TWO 450 AND ONE 650 EXT TANKS	2976.0	19344.0

Figure 1-15 (Sheet 2 of 2)

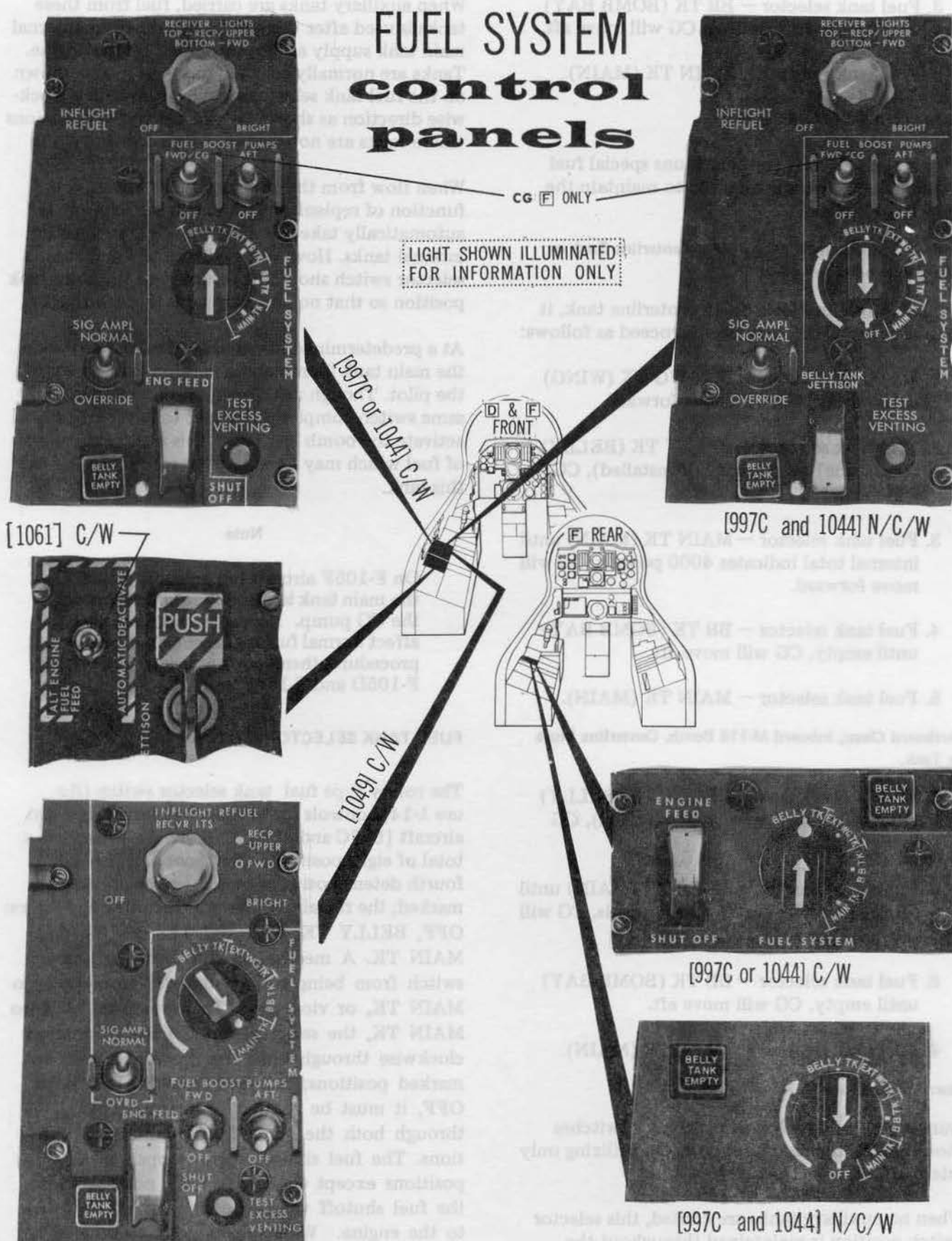


Figure 1-16

3. Fuel tank selector — BB TK (BOMB BAY) until empty (if installed) CG will move aft.
4. Fuel tank selector — MAIN TK (MAIN)

FUEL SYSTEM MANAGEMENT.

With certain aircraft configurations special fuel system management is required to maintain the CG within limits.

Outboard Stores, Inbd Wing Tanks, Centerline Tank or Clean, Expended Ammunition.

If mission requires jettisoning centerline tank, it should be used first, otherwise proceed as follows:

1. Fuel tank selector — EXT WG TK (WING) until empty, CG will move forward.
2. Fuel tank selector — BELLY TK (BELLY) (centerline) until empty (if installed), CG will move aft.
3. Fuel tank selector — MAIN TK (MAIN) until internal total indicates 4000 pounds, CG will move forward.
4. Fuel tank selector — BB TK (BOMB BAY) until empty, CG will move aft.
5. Fuel tank selector — MAIN TK (MAIN).

Outboard Clean, Inboard M-118 Bomb, Centerline Store or Tank.

1. Fuel tank selector — BELLY TK (BELLY) (centerline) until empty (if installed), CG will move aft.
2. Fuel tank selector — MAIN TK (MAIN) until internal total indicates 4000 pounds, CG will move forward.
3. Fuel tank selector — BB TK (BOMB BAY) until empty, CG will move aft.
4. Fuel tank selector — MAIN TK (MAIN).

Normal Management.

During take-off the fuel tank selector switches should be in the main tank position, utilizing only internal fuel.

When no auxiliary tanks are carried, this selector switch position is maintained throughout the entire flight.

When auxiliary tanks are carried, fuel from these tanks is used after take-off to replenish the internal main tank supply as it is consumed by the engine. Tanks are normally selected in the sequence shown on the fuel tank selector switch, reading in a clockwise direction as shown by the arrow. Omit stations where tanks are not carried.

When flow from the auxiliary tanks ceases, the function of replenishing the main tank supply is automatically taken over by the FWD and AFT internal tanks. However, at this time the fuel tank selector switch should be returned to the main tank position so that no auxiliary tank is pressurized.

At a predetermined low fuel level a float switch in the main tank illuminates a caution light to warn the pilot. Though not shown on the diagram, this same switch completes a circuit to automatically activate the bomb bay tank. This assures the usage of fuel which may have inadvertently been left in this tank.

Note

On F-105F aircraft replenishing flow to the main tank is partially supplied through the CG pump. However, this does not affect normal fuel management. The above procedure, therefore, applies to both F-105D and F-105F aircraft.

FUEL TANK SELECTOR SWITCH.

The rotary type fuel tank selector switch (figure 1-14) controls the various fuel tank feeds. On aircraft [997C and 1044] N/C/W the switch has a total of eight positions. The second, third and fourth detent positions on the switch are not marked; the remaining five are placarded as follows: OFF, BELLY TK, EXT WG TK, BB TK, and MAIN TK. A mechanical stop prevents the switch from being rotated directly from OFF to MAIN TK, or vice versa. To move from OFF to MAIN TK, the selector switch must be rotated clockwise through both the unmarked and marked positions; to move from MAIN TK to OFF, it must be rotated counterclockwise through both the marked and unmarked positions. The fuel shutoff valve is open in all positions except OFF. The OFF position closes the fuel shutoff valve, shutting off all fuel flow to the engine. When positioned to the

BELLY TK, EXT WG or BB TK position, electrical power is supplied to open the respective solenoid valve and admit air pressure to the tank, thus permitting the tank to transfer fuel to the internal tanks. The fuel shutoff valve between the aircraft and engine fuel system is also open, allowing fuel flow from the main tank to the engine. When the switch is positioned to the MAIN TK position, the fuel shutoff valve is open, allowing fuel flow to the engine fuel system. In this position fuel will not transfer from any of the external tanks. In the event of power failure the valve will remain in the position it was in when power failed. On aircraft [997C or 1044] C/W the fuel tank selector switch (figure 1-14) is a four-position switch. The positions are placarded BELLY, WING, BOMB BAY and MAIN, which correspond to BELLY TK, EXT WG TK, BB TK and MAIN TK, respectively, on the unmodified selector. Mechanical stops prevent the switch from being rotated counterclockwise from the BELLY and clockwise from the MAIN position. The four placarded positions function the same as the corresponding positions on the unmodified fuel tank selector. The centerline tank jettison switch (Belly Tank) located on the unmodified fuel system control panel is deleted and a fuel shutoff switch is installed in its place. All circuits connected to this switch are powered by DC primary power.

Note

Throughout the text and procedures the BELLY TK (BELLY) position is referred to as the centerline tank.

- If the pilot has inadvertently failed to transfer the bomb bay fuel in proper sequence, and the fuel tank selector switch is in MAIN TK (MAIN), the bomb bay fuel will automatically start to transfer when the FUEL LOW caution light float switch closes. The fuel transfer will continue until the bomb bay tank is empty. Fuel transfer can be discontinued, and the tank vented by positioning the fuel tank selector switch to BELLY TK (BELLY) or EXT WG TKS (WING). Automatic bomb bay feed can also be stopped by cycling the fuel tank selector switch to BB TK (BOMB BAY) and back to MAIN TK (MAIN) position, provided the low level switch has opened.

FUEL SHUTOFF SWITCH [997 or 1044] C/W.

The fuel shutoff switch was incorporated to eliminate relay arcing when rotating the unmodified fuel

tank selector through the unmarked positions with DC power on the system. The fuel shutoff switch (figure 1-14) is a guarded switch with two positions placarded ENGINE FEED and SHUTOFF. The ENGINE FEED position opens the main fuel shutoff valve allowing fuel to flow to the engine. The SHUTOFF position closes the main fuel shutoff valve and this position replaces the OFF position on the unmodified fuel tank selector switch. Two different type guards are used. On aircraft [1044] C/W the guard will remain open. Closing the guard will force the fuel shutoff switch to the ENGINE FEED position. To place the switch in the SHUTOFF position the guard is raised and the switch pulled back to the SHUTOFF position. The guard will remain in the raised position. On aircraft [997C] C/W the guard is spring loaded to the closed position. To move the switch to either position the guard is raised, the switch positioned as desired then the guard will automatically close. On [F] aircraft the fuel shutoff switch is installed in both front and rear cockpits. Both switches must be in the ENGINE FEED position for the main fuel shutoff valve to open. The valve will close if either switch is placed in the SHUTOFF position.

BOOST PUMPS.

Boost pumps are installed in all the internal tanks; the aft fuel tank is equipped with two boost pumps, the forward tank is equipped with one boost and on [F] aircraft the forward tank is also equipped with one center of gravity control transfer pump. The main fuel tank boost pump operates continuously, provided three phase 200-volt AC secondary power is available. The forward and aft tank boost pumps, which are provided with manually operated switches for turning them on and off, also operate from three phase 200-volt AC secondary power. The main tank boost pump supplies fuel to the engine fuel system. The differential pressure between the main tank and the main tank boost pump is used to hold a valve, in the supply line from the forward and aft tanks to the engine fuel supply, in the closed position. In case of main tank boost pump failure, this valve automatically opens, by spring pressure, and allows the output of the forward and aft boost pumps to be directed to the engine fuel system. A check valve in the main tank boost pump outlet will close to prevent fuel from being pumped into the main tank during this operation. The forward and aft pumps are also equipped with a check valve. The check valve in a tank with a failed boost pump is held closed by pressure from other boost pumps. If all boost pumps fail, the check valve opens and fuel is gravity fed (assisted by suction from the engine fuel pump) to the engine. On [F] aircraft the center

of gravity control transfer pump in the forward tank is provided to transfer fuel from the forward tank to keep the aircraft within the permissible forward CG limits. The pump is powered by AC secondary power and will operate only if the forward tank quantity is above 1390 pounds remaining. When the fuel level in the forward tank drops to approximately 1390 pounds remaining the pump is automatically shut off by a float switch. If this pump fails when the fuel quantity in the forward tank is above 1390 pounds remaining a caution light on each cockpit caution panel will illuminate. The pump is controlled by the forward boost pump switch.

CAUTION

The fuel boost pumps will operate on two phases of AC secondary power. If a pump circuit breaker (located in the electronics compartment) from one of the busses disengages because of a defect in that phase, the respective pumps will continue to operate, but at a reduced output; however, once stopped, the pump cannot be restarted.

Note

The forward and aft boost pump caution lights may flash on and off due to sloshing of the trapped fuel in the tank. Therefore, to prevent unnecessary distraction to the pilot, the forward and aft boost pumps may be turned off after the tanks are empty. The lights will remain on after switches are turned off.

Boost Pump Switches.

The forward and aft tank boost pump switches (figure 1-14) placarded FUEL BOOST PUMPS (not in rear cockpit) have positions placarded FWD/CG (FWD) and OFF, and AFT and OFF respectively. The pumps are powered by three-phase, 200-volt AC secondary power, and are controlled by the single-phase 115-volt AC secondary power. When the switches are in the FWD/CG (FWD) or AFT position, single-phase power energizes the respective relays, permitting three-phase, 200-volt, AC secondary power to energize the respective pumps. When the switches are in the OFF position, the control relays are deenergized, shutting off the three-phase, 200-volt AC secondary circuit to the respective pumps, making the pumps inoperative.

If the single phase control power fails, the pumps will become totally inoperative; however, if one of the other two phases fail, the pumps will continue to operate at a reduced output.

Note

- Ⓔ If the forward boost pump switch is in the FWD/CG position the center of gravity control transfer pump in the forward fuel tank will operate (providing AC power is available) until the fuel level in the forward fuel tank drops to 1390 pounds remaining at which time the pump will shut off.

Alternate Engine Fuel Feed Switch [1061] C/W.

The alternate engine fuel feed switch, (figure 1-14) located on the left console outboard of the auxiliary canopy jettison handle (not in rear cockpit), is a two-position switch placarded ALT ENGINE FUEL FEED with positions marked DEACTIVATE and AUTOMATIC. In the AUTOMATIC position fuel flow is normal until the fuel leak sensing system detects a leak in the fuel line from the main tank to the transfer shutoff valve. If the leak is sustained for 5 to 10 seconds the following action occurs:

- The transfer shutoff valve closes and fuel will flow from the main tank until it is empty then fuel flow to the engine will be directly from the forward and aft tanks through the by-pass valve.
- Automatic bomb bay fuel feed circuit is deactivated.
- On Ⓔ aircraft the forward CG pump circuit is deactivated.
- The fuel purging valve is closed.
- The fuel leak caution light will illuminate.

The DEACTIVATE position deenergizes the fuel leak sensing system and fuel system functions the same as on unmodified aircraft. The fuel leak caution light will illuminate and remain illuminated until the switch is positioned to the AUTOMATIC position or loss of DC power occurs. The fuel leak sensing system is powered by AC secondary power. The transfer shutoff valve is powered by DC primary power.

On F-105D and F-105F aircraft modified by T.O. 1F-105-1020, the Revised Fuel System as provided by T.O. 1F-105-1061 has been deactivated.

Power has been removed from the ALTERNATE ENGINE FUEL FEED switch so that it is now INACTIVE in both positions and the fuel leak sensing system is no longer operative (1020 C/W). The fuel system now functions as on the aircraft not modified by T.O. 1F-105-1061. The following differences will be noted after T.O. 1F-105-1020 has been complied with:

a. The transfer shutoff valve (labeled MAIN TRANSFER SHUTOFF VALVE in figure 1-12 (sheet 3 of 3) in basic manual) is deactivated in the open position so that the fuel flow through it is continuous.

b. The fuel leak caution light is deactivated and will not illuminate.

JETTISON SYSTEM.

Integral pylon and tank units are jettisoned from the wing and fuselage centerline (belly) by electrically fired explosive cartridges in the pylons. Wing pylons, with or without stores, are also jettisoned by electrically fired explosive cartridges. The jettison system is powered by DC primary power. However, if DC primary power is not available, battery power is automatically supplied to the jettison system. When jettisoning is required, left and right wing pylons will be jettisoned simultaneously.

CAUTION

When a bomb bay tank or SUU-21/MN-1A dispenser is installed in the bomb bay, it is a fixed installation and no attempt shall be made to jettison it. The special store locking handle shall be left in the LOCKED (full forward) position with the pip pin installed and the displacing gear pressure should read zero (+25) PSI.

The jettison controls allow the pilot a choice, or combination, of any of the following:

- Jettison all pylons (with attached tanks or stores).
- Jettison centerline pylon and tank.
- Jettison inboard wing pylons (with tanks or stores).
- Jettison outboard wing pylons (with stores).

Note

The AIM-9B (Sidewinder) and the AGM-12B (Bullpup) adapters cannot be jettisoned.

Jettison External Stores Button.

The jettison external stores button (figure 1-5) on the left auxiliary instrument panel is provided to jettison all pylons and any tanks or stores (except special weapons, AGM-12B/C, AIM-9B/E, or AGM-45B missiles) that may be installed on them. The button is placarded JETTISON EXTERNAL STORES. When the button is depressed, DC primary power is supplied to explosive cartridges in each pylon, releasing the pylons. A time delay

feature provides a 0.6 second delay between jettisoning of inboard and outboard pylons. A holding relay keeps the circuit energized 1.2 seconds so that the button does not have to be held depressed. If DC primary power is not available, battery power is automatically supplied to the jettison system.

Pylon Jettison Buttons.

The pylon jettison buttons (2, figure 1-7) on the right console (not in rear cockpit) are provided to jettison pylons and any tanks or stores (except special weapons AGM-12B/C, AIM-9B/E or AGM-45B missiles) that may be installed on the respective pylon. The buttons are grouped under a placard marked JETTISON PYLONS, and are individually placarded INBD, CENTER and OUTBD. When any of the three buttons is depressed, DC primary power is directed to explosive charges in the respective pylons releasing the pylons. In the event DC primary power is not available, battery power is automatically supplied to the system.

Centerline Tank Jettison Switch (Belly Tank) [997C and 1044] N/C/W.

The centerline tank jettison switch (figure 1-13) on the fuel system control panel (not in rear cockpit) is provided to jettison the centerline pylon and any tank or store that may be installed. The switch placarded BELLY TANK JETTISON is a two-position switch guarded in the unmarked OFF position. When the guard is lifted and the switch positioned to JETTISON, DC primary power is supplied to explosive cartridges in the centerline pylon, releasing the pylon. If DC primary power is not available, battery power is automatically supplied to the system.

CAUTION

Do not open the bomb bay doors when carrying the centerline pylon tank or the centerline pylon multiple ejection rack assembly as tanks or stores will jettison and doors may be damaged.

- To prevent inadvertent jettisoning of the multiple ejection rack assembly, the centerline tank jettison switch guard shall be safetied when the rack is installed on the centerline pylon.

FUEL QUANTITY INDICATOR and selector switch

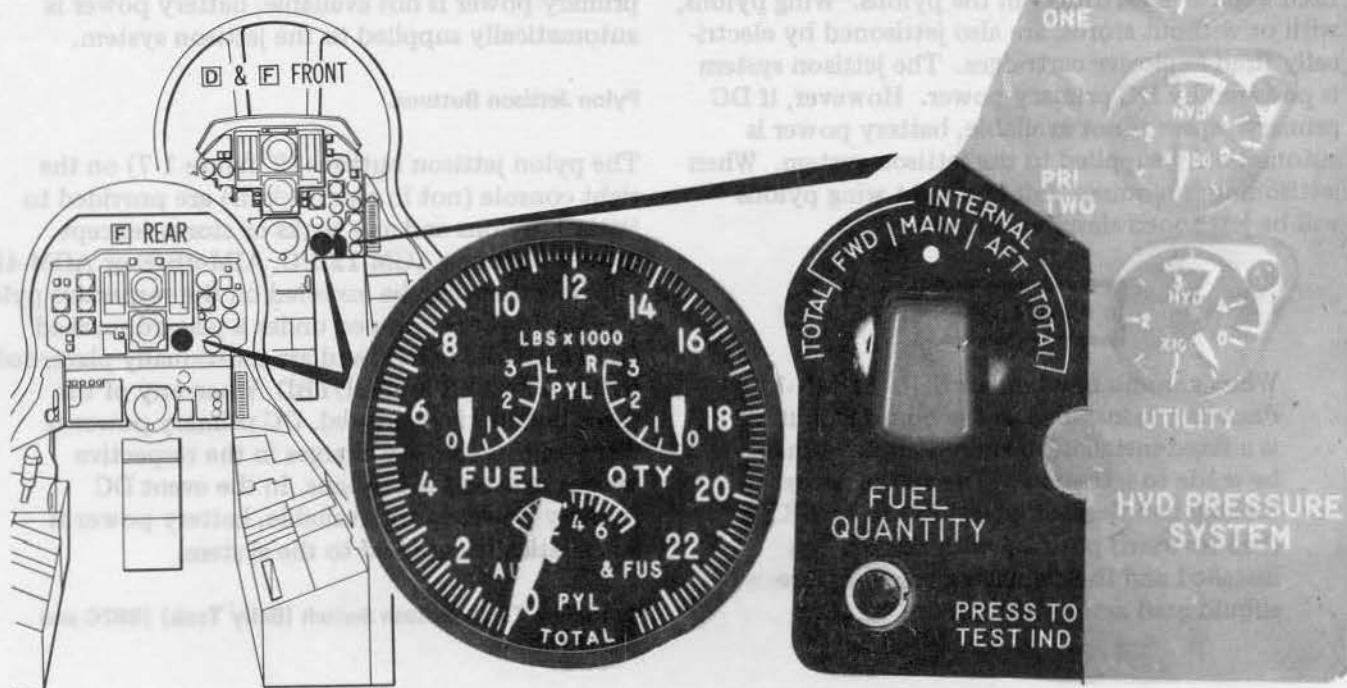


Figure 1-17

Inboard MER Jettison Switch.

The inboard MER jettison switch (1, figure 1-7) on the right console (not in rear cockpit) is a two-position toggle switch placarded JETTISON INBD MER and is powered by DC primary power.

Note

When carrying MER on inboard pylons, the cartridges are removed making this switch ineffective. To jettison the pylon and MER together, it is necessary to engage the inboard pylon jettison button.

FUEL SYSTEM INDICATORS.

Fuel Quantity Indicators.

A fuel quantity indicator (figure 1-17) is provided to indicate fuel on board and is powered by 115-volt AC primary power. The system indicates in pounds and since it is a capacitance type, compensates for changes in fuel density. The auxiliary

tank quantities (left pylon tank, right pylon tank and auxiliary bomb bay or centerline pylon tank) are indicated on three small dials on the face of the indicator. The auxiliary or pylon tank dials are graduated in 500 pound units. The large outer scale, graduated in 200 pound units, indicates total (internal plus external), total internal or the individual internal tanks, depending on the position of the fuel quantity selector switch. When wing tanks are jettisoned, the left and right pylon dials will indicate slightly below zero. When the centerline pylon tank is jettisoned the auxiliary and fuselage dial will indicate the amount of fuel in the bomb bay tank only. On the [F] aircraft the front cockpit has the master indicator and the rear cockpit has a repeater indicator.

Fuel Quantity Selector Switch.

The fuel quantity selector switch (figure 1-17) (not in the rear cockpit) is powered by 115-volt AC primary power. The detented positions of the rotary switch from left to right are as follows: TOTAL for all fuel on board (internal plus auxiliary fuel), FWD for fuel in the forward tank, MAIN for fuel in the main tank, AFT for fuel in the aft tank and

INTERNAL TOTAL for all internal fuel on board (internal exclusive of auxiliary fuel).

CAUTION

The INTERNAL TOTAL position should be used for monitoring fuel quantity. This position will show fuel available to the engine regardless of the position of the fuel tank selector.

- As a result of inherent calibration tolerances in each individual indicating system, adding the individual indicated quantities may or may not equal the actual total quantity.
- Therefore, the total amount of internal fuel remaining, obtained by adding the individual quantities, should be used only as an approximation of the actual amount of internal fuel on board.

The fuel quantity indicating system on a fully serviced aircraft should indicate as follows:

D AIRCRAFT

Tank	Indicator Reading		
	Self-sealing	Bladder	Tolerance
FWD	2150	2400	±500 LB
MAIN	1600	1700	±500 LB
AFT	2900	3300	±550 LB
INTERNAL TOTAL	6800	7400	±600 LB
L PYL	2850	2850	±300 LB
R PYL	2850	2850	±300 LB
AUX & FUEL PYL			
Bomb Bay	2450	2500	±400 LB
450 GAL C/L	2850	2850	±400 LB
650 GAL C/L	4200	4200	±400 LB

F AIRCRAFT

Front Cockpit Master Indicator

Tank	Indicator Reading		
	Self-sealing	Bladder	Tolerance
FWD	2150	2400	±300 LB
MAIN	1600	1700	±300 LB
AFT	2900	3300	±350 LB
INTERNAL TOTAL	6800	7400	±400 LB
L PYL	2850	2850	±200 LB
R PYL	2850	2850	±200 LB

AUX & FUSE PYL

Bomb Bay	2450	2500	±300 LB
650 GAL C/L	4200	4200	±300 LB

Rear Cockpit Repeater Indicator

Tank	Indicator Reading
FWD	Master Ind. (±240) LB
MAIN	Master Ind. (±240) LB
AFT	Master Ind. (±240) LB
INTERNAL TOTAL	Master Ind. (±240) LB
L PYL	Master Sub dial (±155) LB
R PYL	Master Sub dial (±155) LB
AUX & Bomb Bay	Master Sub dial (±355) LB
FUSE PYL	650 Centerline Master Sub dial (±355) LB

Fuel Quantity Indicator Test Button.

The fuel quantity indicator test button (figure 1-17) (not in rear cockpit) is located on the right side of the indicator and placarded FUEL QUANTITY and PRESS TO TEST IND. When the button is depressed, all pointers should move toward zero. When the button is released, the pointers should return to their original position. Failure of the pointers to move indicates a faulty system.

Fuel Flow Indicators.

Refer to "Engine Instruments" in this section.

Excess Fuel Vent Caution Light.

The excess fuel vent caution light (figure 1-60) on the instrument panel displays EXCESS FUEL VENT and is powered by DC secondary power. Illumination of the light indicates that fuel flowing from the internal tanks through the fuel vent line exceeds 1000 pounds per hour. A capacitance type switch in the fuel vent line senses the excessive fuel flow and energizes a holding relay. If the relay is energized continuously for 15 to 20 seconds the caution light will illuminate.

Test Excess Venting Button.

The test excess venting button (figure 1-14) (not in rear cockpit) is placarded TEST EXCESS VENTING. Depressing the button connects a simulator capacitor to the circuit. After 15 to 20 seconds the EXCESS FUEL VENT caution light will illuminate indicating the entire system is operating.

Fuel Low Caution Lights.

The fuel low caution light (figure 1-60) is located on the caution light panel and displays FUEL LOW and is powered by DC secondary power. Illumination of the light indicates the total fuel remaining in the main tank is 1100 (± 200) pounds [1058 and 1059] N/C/W, 1000 (± 200) pounds [1058 and 1059] C/W, (when in normal flight attitude). Fuel from the bomb bay tank transfers automatically to the main tank when the fuel low caution light float switch closes, if the pilot has left the fuel selector in the MAIN TK (MAIN) position and neglected to select the BB TK (BOMB BAY) position. The automatic provisions do not change present pilot procedures of selecting the BB TK (BOMB BAY) position in the proper sequence.

CAUTION

On aircraft [1058 and 1059] C/W the fuel low caution will illuminate when the total fuel remaining in the main tank is 1000 (± 200) pounds.

Note

If AC secondary power fails, the boost pumps will become inoperative, causing the transfer of fuel from the forward and aft tank to the main tank to be discontinued. All internal tanks will then supply fuel directly to the engine, assisted by gravity and suction from the engine driven pump. Therefore the fuel low caution light will illuminate while the forward and aft tanks may still contain fuel, in addition to the 1100 (± 200) [1058 and 1059] N/C/W 1000 (± 200) pounds [1058 and 1059] C/W pounds in the main tank.

Fuel Inlet Pressure Caution Light.

The fuel inlet pressure caution light (figure 1-60) located on the caution light panel displays FUEL INLET PRESS and is powered by DC primary power. Illumination of the light indicates low pressure in the fuel line downstream of the fuel shutoff valve. As the differential pressure between the fuel line and the static pressure in the main tank increases and reaches four PSI, the light will go out. As pressure decreases the light will illuminate when the

differential pressure reaches one PSI. The light will illuminate under the following conditions:

- Fuel shutoff valve closed.
- All boost pumps inoperative. Under this condition the forward and aft tanks will discontinue transferring the fuel to the main tank, all internal tanks will then gravity feed directly to the engine. The fuel heads will equalize and the fuel remaining in each tank will gravity feed until all usable fuel is consumed.
- Main boost pump inoperative and the bypass valve failed to transfer. Under this condition the forward and aft boost pumps will continue to transfer fuel to the main tank from which it will gravity feed to the engine.

Boost Pump Caution Lights.

Three boost pump caution lights (figure 1-60) located on the caution light panel display FWD BOOST PUMP, MAIN BOOST PUMP, and AFT BOOST PUMP and are powered by DC secondary power. Differential pressure between the respective pump inlet and outlet pressure actuate switches to illuminate and extinguish the respective boost pump caution lights. As pressure differential decreases, the respective caution light will illuminate at one PSI. On increasing pressure, the caution light will go out at four PSI. The aft boost pump caution light is actuated by the low differential pressure of either or both, boost pumps in the aft tank. Illumination of any boost pump caution light indicates that the pressure differential between the inlet and outlet ports of the pump has decreased to or below one PSI. The following conditions will cause the boost pump caution lights to light:

- Inoperative boost pump (pump off or failed).
- Empty fuel tank.
- Fuel sloshing in tank.
- Deceleration or change in attitude when aft tank is not full.

CG Control Transfer Pump Caution Light [F] .

The CG control transfer pump caution light (figure 1-60) is located on the caution light panel and is powered by DC primary power. The light will illuminate and display CG PUMP whenever the transfer

pump is not operating and the forward tank is above 1390 pounds remaining. When the fuel in the forward tank is below 1390 pounds remaining, the light will go out. The light may flicker momentarily during A/B light-up due to fuel sloshing in the forward tank if the forward boost pump switch is in the OFF position.

Centerline Pylon Tank Empty Indicator Light.

The centerline pylon tank empty indicator light (figure 1-60) displays BELLY TANK EMPTY and is powered by DC primary power. The light will illuminate when the tank is empty and will go out when the tank is jettisoned.

Fuel Leak Caution Light [1061] C/W.

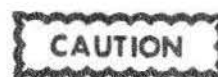
The fuel leak caution light, (figure 1-60) located on the main instrument panel adjacent to the excess fuel vent light (not in rear cockpit), is a yellow light placarded FUEL LEAK and powered by DC primary power. Illumination of the light indicates that the alternate engine fuel feed switch is in the DEACTIVATE position or a fuel leak signal has been generated if the alternate engine fuel feed switch is in the AUTOMATIC position.

AIR REFUELING SYSTEM.

The aircraft can be refueled in flight from a tanker aircraft equipped with a drogue or flying boom. A control (not in rear cockpit) permits extension or retraction of a probe on the forward left side of the fuselage, or opening and closing of a flush door (slipway) on the top forward fuselage ahead of the center windshield panel, exposing a fixed refueling receiver. Transfer of fuel from a tanker equipped with a drogue is accomplished when the coupling mounted to the drogue is engaged with the refueling probe on the left side forward fuselage of the aircraft. With the tanker drogue in position and the receiver refueling probe extended, the pilot flies the probe into the cone of the drogue until the nozzle on the probe engages the coupling mounted to the drogue. When engagement is completed, transfer of fuel is initiated by the tanker engineer. Fuel transfer through the probe is automatically distributed through the manifold to all internal and installed auxiliary tanks, i.e., wing pylon, centerline pylon, and bomb-bay tanks. As each internal tank becomes full, float-operated fuel shutoff valves within the tank close, preventing further flow from the manifold. Float-operated switches in the auxiliary tanks control the airframe mounted shut-off valves. As each auxiliary tank becomes full, the

float-operated switch opens and stops further fuel from the manifold. Upon completion of the refueling operation, the probe drogue connection is broken by the receiver dropping back. The breakaway force in the disconnect in the drogue is adjusted so that undue strain on the connection will cause an automatic disconnect. Self-sealing disconnects on both probe and drogue prevent fuel spillage. For transfer of fuel from a tanker equipped with a flying boom, the aircraft is equipped with a flush receptacle in addition to the refueling probe. A flush fixed-type air-refueling receptacle is mounted on the top forward fuselage ahead of the center windshield panel. A flush drop-down door retracts into the fuselage to expose the receptacle and provide a slipway to guide the tanker boom during refueling. The drop-down door is hydraulically actuated and spring-loaded to retract (open) in the event of utility hydraulic failure. Once the receptacle door is open and the tanker boom is inserted in the receptacle, the nozzle latch rollers are actuated to the locked position. The operation of the receptacle latches and the manual and automatic disconnect features are controlled by a signal amplifier. Fuel transfer through the receptacle is accomplished as in the probe system. Disconnect can be accomplished by the following actions:

1. Boom operator disconnects by actuating the tanker disconnect switch.
2. Receiver pilot disconnects by depressing the radar action reject/air refueling disconnect button on the throttle grip.
3. Receiver pilot disconnects by depressing and holding the air refuel reset button.
4. Initiate a "Brute Force" disconnect. When all normal methods of disconnect fail, a tension force of approximately 4800 pounds on the nozzle will effect a disconnect as a last resort procedure. If the boom operator can maintain a 60-pound fuel pressure in the fuel manifold, the necessary force can be reduced to 3330 pounds.



It is not necessary to jerk the boom out with IDLE power and speed brakes. This method has caused serious structural damage. A gradual reduction in power will suffice to disconnect.

5. ATM can be turned OFF in an effort to deplete utility hydraulic pressure holding the latch locks closed.

An automatic disconnect will occur when both receiver and tanker systems are completely operational and one of the following occurs:

1. Excessive fuel pressure occurs in the receiver fuel manifold, actuating the high pressure disconnect switch.
2. The tankers boom limit switches (see T.O. 1-1C-1-13) are actuated due to excessive (angular) displacement of the boom.

An amplifier override switch is provided to supply an emergency method of controlling hook-up or release of the tanker boom in the event of amplifier failure or malfunction. See figure 1-18 for the refueling system.

WARNING

- Ⓛ The angle of attack vane is in a very precarious location during air refueling and is subject to loss and/or damage during hook-ups. Extreme care must be exercised to prevent breaking the vane off with possible engine ingestion.

SIGNAL AMPLIFIER.

The signal amplifier contains a thyatron tube, a ballast, resistors, four multiple contact relays and is the nerve center of the air refueling signal system. With the air refuel handle pulled aft and the signal amplifier override switch in the NORMAL position DC primary power energizes the signal amplifier. Normally closed contacts of the relays in the amplifier complete circuits which arms the nozzle contact switch, arms the nozzle latch switch and illuminates the air refuel ready light. When contact is made, the nozzle depresses a slide valve in the receptacle which in turn actuates the nozzle contact switch. This action indexes the control valve to apply hydraulic pressure to close the nozzle latches. When the nozzle latches close the nozzle latch switch is actuated completing a circuit which energizes the induction coil and sends an electrical impulse to the amplifier causing the thyatron tube to actuate relays in the amplifier. This extinguishes the air refuel ready light, arms the disconnect switch

on the throttle grip, arms the fuel pressure switch and transmits a signal from the induction coil through the nozzle coil to the tanker indicating that refueling may begin. A disconnect signal, from any source, received by the amplifier causes actuation of relays which deenergizes the latch control valve applying hydraulic pressure to retract the latches releasing the nozzle and illuminating the air refuel disconnect light. When the radar action reject/air refuel disconnect button on the throttle is depressed or the air refuel handle is pushed in power is removed from the signal amplifier and the air refuel disconnect light goes out.

AIR REFUEL HANDLE.

The air refuel handle (figure 1-19) (not in rear cockpit) is placarded RECP-PULL and PROBE-TURN & PULL. When the handle is in the vertical position and pulled aft, a mechanical control positions the hydraulic control valve to retract (open) the slipway door. When the door is fully open, circuits are energized to illuminate the air refuel ready light and the two lights in the receptacle well, and open the fuel transfer and refueling valve in each external tank. Once the receptacle flush-type door is open and the tanker boom is inserted in the receptacle, the nozzle latch rollers are actuated to the locked position and the air refuel ready light goes out. When the tanker disconnects, the AIR REFUEL DISC indicator light illuminates. The light will remain illuminated until the air-refuel handle is pushed in, or the AIR REFUEL RESET button is momentarily depressed. When the air-refuel handle is rotated 90 degrees counterclockwise while in the full forward position and then pulled aft, a cable unlocks the forward door and positions a hydraulic-selector valve to direct utility hydraulic pressure to extend the probe. The door on the forward end of the probe compartment opens to allow passage of the probe assembly. When the probe is extended, the forward door returns to its faired position, and circuits are energized to illuminate the probe upward and forward shining probe lights and open the fuel transfer and refueling valve in each external tank. The upward shining light is mounted on the fuselage forward of the probe and illuminates the area forward of the probe. The forward shining light is mounted on the probe and illuminates the area around the probe nozzle. Hydraulic pressure holds the probe in the extended position until fuel transfer is accomplished and a disconnect is initiated. Pushing in the air-refueling handle mechanically actuates the hydraulic-selector valve to retract the refueling probe. The initial movement opens the forward door and allows the probe to retract into the compartment. When the

REFUELING SYSTEM

CODE

- REFUELING FLOW
- - - TRANSFER FLOW
- VENT
- AIR PRESSURE
- ELECTRICAL CONNECTION
- CHECK VALVE
- REFUELING VALVE
- BOOST PUMP AND FLAPPER VALVES

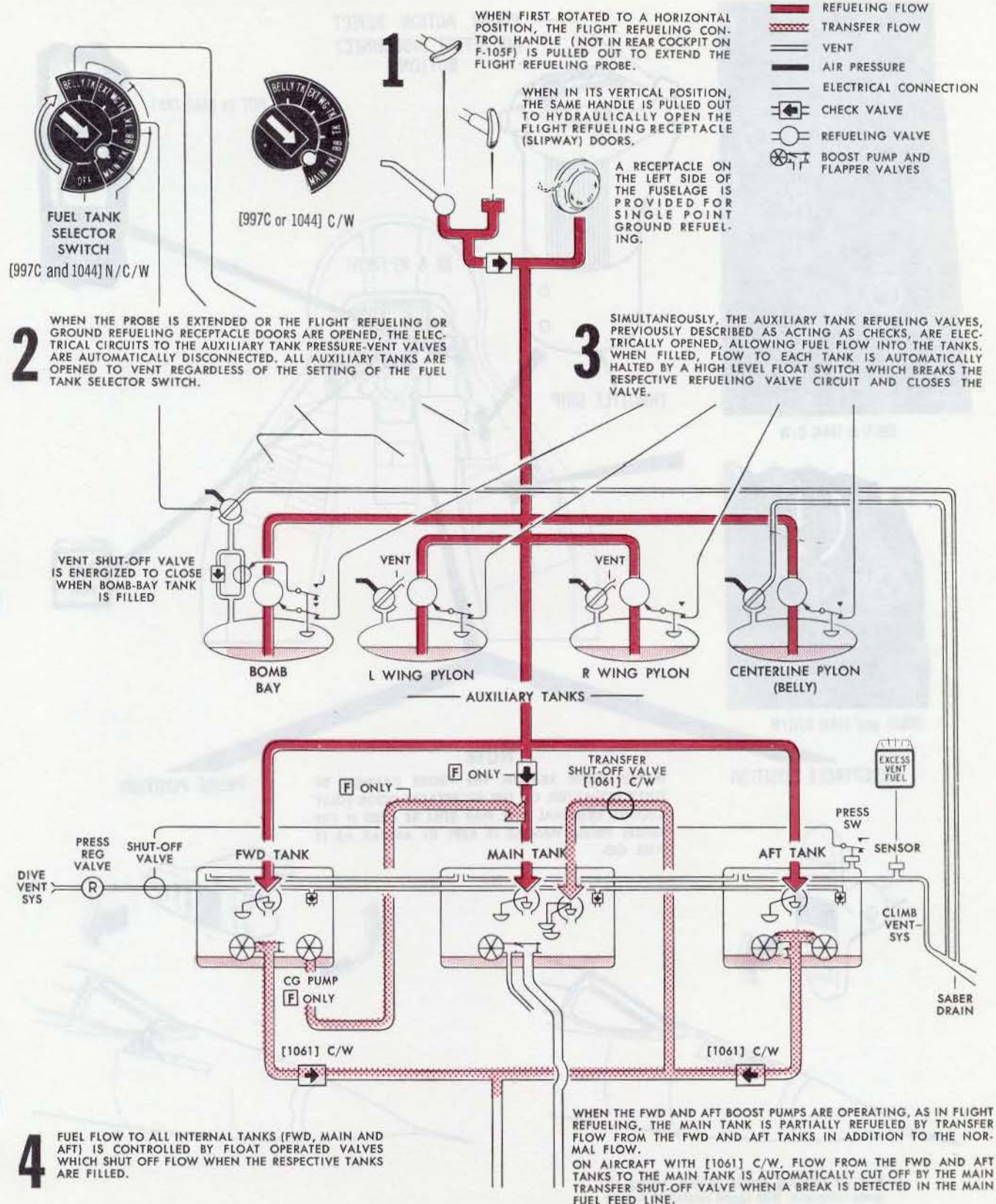
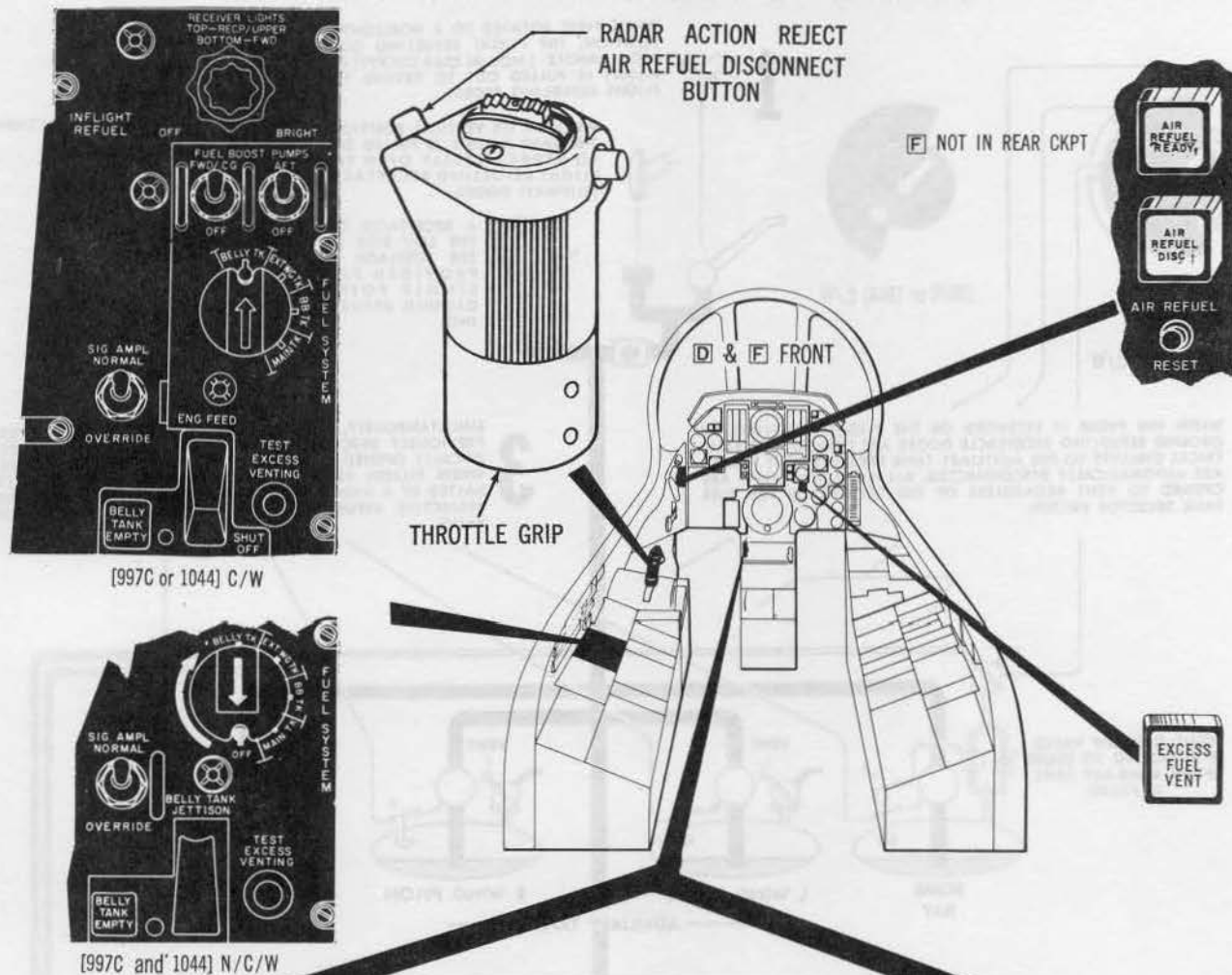


Figure 1-18

REFUELING SYSTEM **controls**

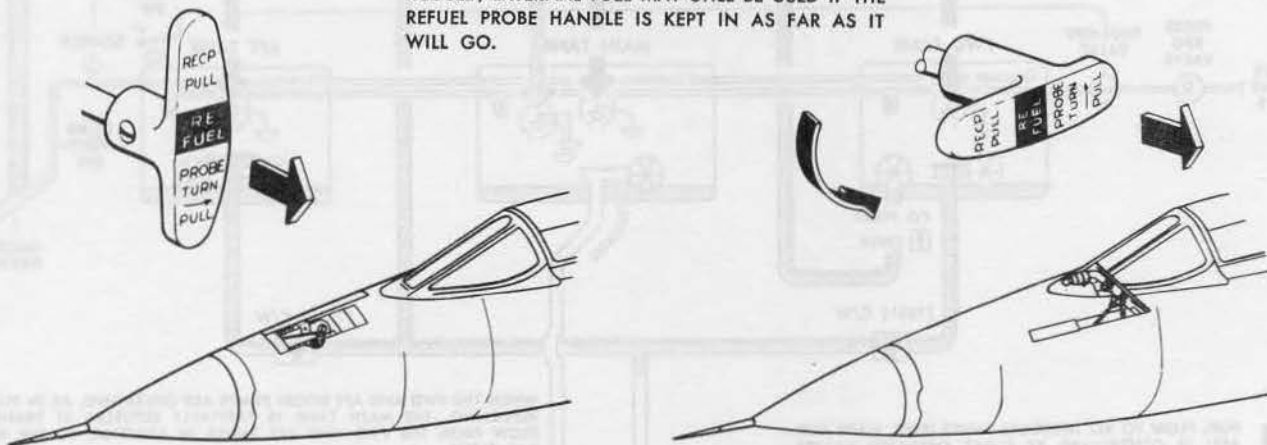


RECEPTACLE POSITION

NOTE

IF FOR SOME REASON THE PROBE CANNOT BE FULLY RETRACTED, OR THE RECEPTACLE DOOR FULLY CLOSED, EXTERNAL FUEL MAY STILL BE USED IF THE REFUEL PROBE HANDLE IS KEPT IN AS FAR AS IT WILL GO.

PROBE POSITION



With air refueling handle vertical, pulling aft opens receptacle. With handle rotated 90 degrees CCW, pulling aft extends probe.

Figure 1-19

linkage is fully retracted, the forward door is faired to the aircraft and the lock secures the probe in the retracted position, the refueling circuit is deenergized, and the probe lights are extinguished. If hydraulic pressure is not available, a spring-loaded level under the probe tube will extend the probe sufficiently to allow complete extension by ram-air pressure. When the probe is extended by means of the normal or the emergency systems, the refuel control electrically positions the auxiliary tank pressure vent valves to vent position. When the handle is pushed in, the pressure vent valves are positioned by the fuel-selector position. After the refueling cycle is completed under emergency extension, the probe cannot be retracted.

CAUTION

If the refueling probe is extended without hydraulic pressure, or if the probe cannot be fully retracted, the air-refuel probe handle must be pushed in after the refueling cycle is completed, in order to return the pressure vent valves in the auxiliary tanks to the pressure position and allow fuel to transfer from these tanks. Extended probe will reduce range approximately 15 percent.

WARNING

Selection of receptacle or probe shall only be made while the handle is pushed in. If any attempt is made to rotate the handle in the extended position, the linkage will be disconnected and both refueling systems rendered inoperative.

SIGNAL AMPLIFIER OVERRIDE SWITCH.

The signal amplifier override switch (figure 1-19) (not in rear cockpit) provides an emergency method of hook-up and release of the tanker boom in the event of amplifier, high-pressure switch, or induction coil failure. The switch is placarded SIG AMPL and has two positions placarded NORMAL and OVERRIDE. During the normal refueling cycle, the switch remains in the NORMAL position and air refueling system power and actuating signals function automatically through the amplifier

and the refueling sequence is automatic after contact is made. If the amplifier fails, fuel may or may not be transferred, and the ready light may not illuminate or may not go out after contact is made. When this occurs, the override switch should be placed in the OVERRIDE position which bypasses the following items: Air refuel amplifier, latch switch, induction coil, high pressure switch and air refuel reset button. In OVERRIDE when the nozzle contact switch has actuated the latch control valve, there is no light action, no signals are passed to the tanker, and the tanker cannot actuate the disconnect cycle. The receiver pilot must verbally (using radio) inform the tanker he is ready to receive fuel and upon request of the boom operator, must initiate the disconnect cycle at the conclusion of refueling. Disconnect is accomplished by depressing the radar action reject/air refuel disconnect button on the throttle. In the event the button does not effect a disconnect a brute force disconnect is still possible.

AIR REFUEL READY INDICATOR LIGHT.

The air refuel ready indicator light (figure 1-60) powered by DC primary power through the signal amplifier, is a green legend type light displaying AIR REFUEL READY when illuminated, indicating that the receiver is open, power is supplied to the refueling amplifier and the amplifier is ready for the refueling cycle. The ready light will go out when contact is made and the receiver latches have closed.

AIR REFUEL DISCONNECT INDICATOR LIGHT.

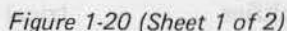
The air refuel disconnect indicator light (figure 1-60) powered by DC primary power through the signal amplifier, is an amber legend type light displaying AIR REFUEL DISC. When illuminated it indicates that the tanker boom nozzle has been disconnected from the receiver. If the disconnect light is illuminated, the reset button below the light must be depressed or the air refuel handle must be pushed in and pulled out to close and open the slipway door, before the refueling system will be ready to make another refueling cycle.

AIR REFUEL RESET BUTTON.

The air refuel reset button (figure 1-5) (not in rear cockpit) powered by DC primary power recycles the air refueling amplifier to allow resumption of refueling in the event of a premature disconnect.

Note

- Depressing the reset button removes electrical power from the refueling amplifier



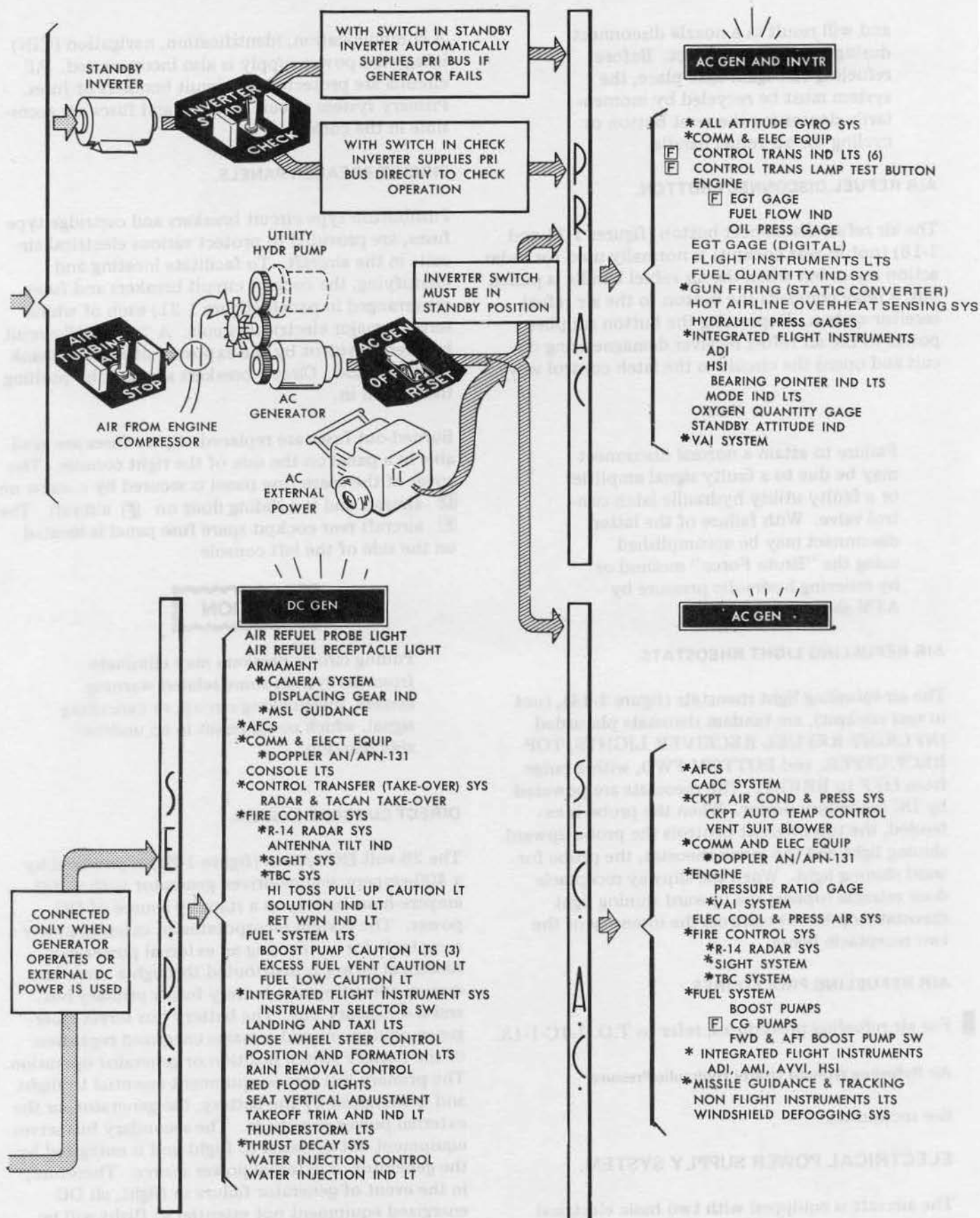


Figure 1-20 (Sheet 2 of 2)

and will result in a nozzle disconnect during a refueling contact. Before refueling can again take place, the system must be recycled by momentarily depressing the reset button or cycling the air-refuel handle.

AIR REFUEL DISCONNECT BUTTON.

The air refuel disconnect button (figures 1-11 and 1-18) (not in rear cockpit) is normally used for radar action reject but when the air refuel handle is pulled out, a relay connects the button to the air refuel receiver system. Depressing the button supplies power to the air refuel receiver demagnetizing circuit and opens the circuit to the latch control valve.

Note

Failure to attain a normal disconnect may be due to a faulty signal amplifier or a faulty utility hydraulic latch control valve. With failure of the latter, disconnect may be accomplished using the "Brute Force" method or by relieving hydraulic pressure by ATM shutdown.

AIR REFUELING LIGHT RHEOSTATS.

The air-refueling light rheostats (figure 1-14), (not in rear cockpit), are tandem rheostats placarded INFLIGHT REFUEL RECEIVER LIGHTS, TOP-RECP/UPPER, and BOTTOM-FWD, with a range from OFF to BRIGHT. The rheostats are powered by DC secondary power. When the probe is extended, the top rheostat controls the probe upward shining light and the lower rheostat, the probe forward shining light. When the slipway receptacle door retracts (opens) the upward shining light rheostat (top knob) controls the intensity of the two receptacle lights.

AIR REFUELING PROCEDURES.

For air-refueling procedures, refer to T.O. 1-1C-1-13.

Air Refueling Without Utility Hydraulic Pressure.

See section III.

ELECTRICAL POWER SUPPLY SYSTEM.

The aircraft is equipped with two basic electrical power supply systems (figure 1-20): DC and AC.

A communication, identification, navigation (CIN) integrated power supply is also incorporated. All circuits are protected by circuit breakers or fuses. Primary system circuit breakers and fuses are accessible in the cockpit.

CIRCUIT BREAKER PANELS.

Pushbutton type circuit breakers and cartridge type fuses, are provided to protect various electrical circuits in the aircraft. To facilitate locating and identifying, the cockpit circuit breakers and fuses are arranged in panels (figure 1-21) each of which serves a major electrical circuit. A "popped" circuit breaker is evident by the exposure of a white shank on the button. Circuit breakers are reset by pushing the button in.

Burned-out fuses are replaced. Spare fuses are available in a panel on the side of the right console. The cover of the spare fuse panel is secured by a screw on  aircraft and is a sliding door on  aircraft. The  aircraft rear cockpit spare fuse panel is located on the side of the left console.

CAUTION

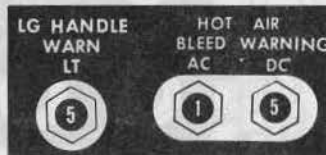
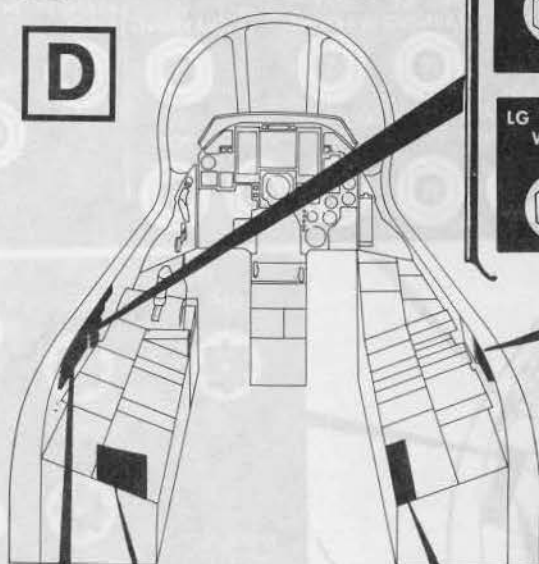
Pulling circuit breakers may eliminate from the system some related warning system, interlocking circuit, or cancelling signal, which could result in an undesirable reaction.

DIRECT CURRENT SYSTEM.

The 28-volt DC system (figure 1-20) is powered by a 400-ampere, engine-driven generator with a 100-ampere-hour battery as a standby source of DC power. The system incorporates an external power receptacle for connecting an external power cart. Electrical power is distributed through a three bus system consisting of a battery bus, a primary bus, and a secondary bus. The battery bus serves emergency equipment and remains energized regardless of the battery switch position or generator operation. The primary bus serves equipment essential to flight and is energized by the battery, the generator, or the external power receptacle. The secondary bus serves equipment not essential to flight and is energized by the generator or external power source. Therefore, in the event of generator failure in flight, all DC energized equipment not essential to flight will be automatically cut out since DC secondary power

CIRCUIT BREAKER panels

D



[997C or 1044] C/W

added by
[1045]



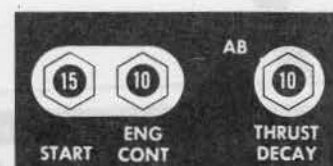
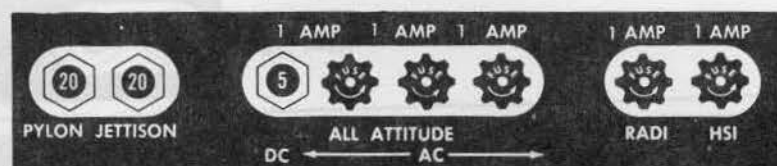
[997C and 1044]
N/C/W



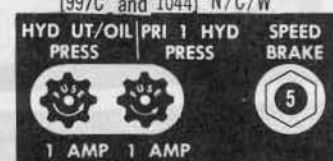
[1061] C/W



[997C or 1044] C/W



[997C and 1044] N/C/W



D 5 6 10 placarded: ELECT SYS CNTRL PWR

Figure 1-21 (Sheet 1 of 3)

added by [1045]

F front

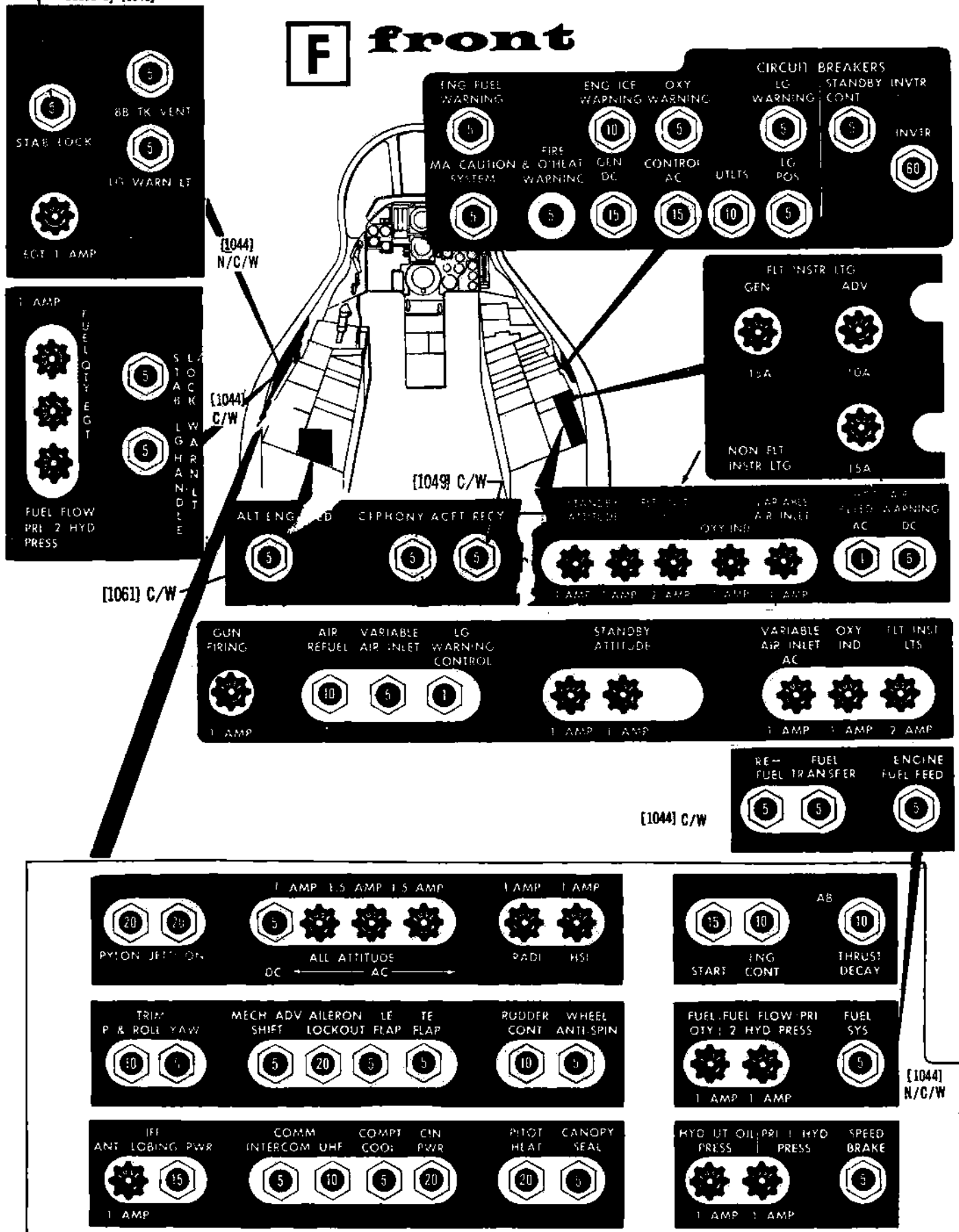


Figure 1-21 (Sheet 2 of 3)

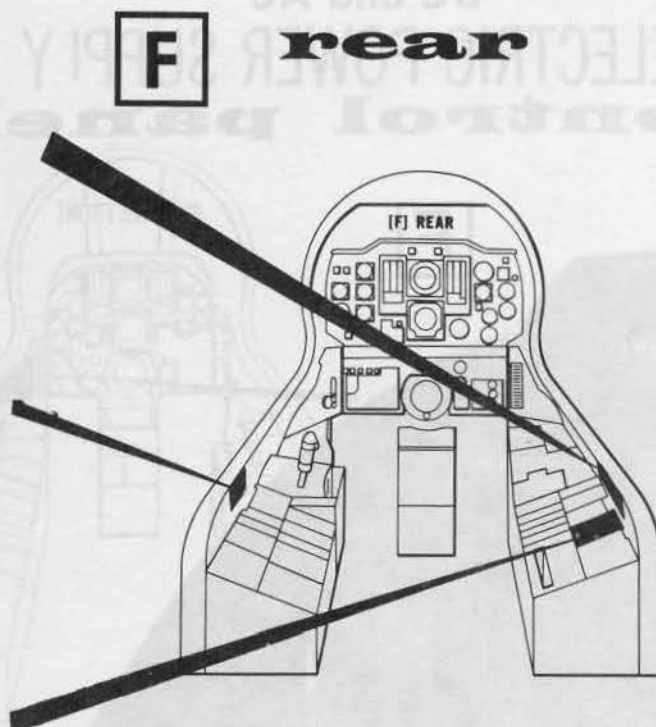


Figure 1-21 (Sheet 3 of 3)

will not be energized, and battery power will be conserved for DC primary powered equipment. A fully charged battery is capable of supplying the DC primary power load on the [F] for 1.2 hours and on the [D] for 1.5 hours. If the CIN (ELECT SYS CNTRL PWR) power circuit breaker is pulled out and use of the Command Radio, Intercom and IFF/SIF is restricted to 10 minutes of operation, the battery time may be extended to 2.1 hours on the [F] and 3.5 hours on the [D] aircraft. If both AC and DC generators fail or engine flameout occurs, a fully charged battery is capable of supplying all DC primary powered loads, including the standby inverter for 0.6 hour on the [F] and 0.9 hour on the [D]. If the generator output is below battery voltage or between 32 to 34 volts for a period of 10 seconds a protective circuit automatically disconnects the generator from the electrical circuit and illuminates a caution light. Above 34 volts the time delay decreases and disconnect is instantaneous at 50 to 70 volts. The generator may be reset into the system by proper use of the three-position generator switch.

CAUTION

The battery is the sole source of DC power during flight with the DC generator inoperative and must not be used on the ground for extended periods in lieu of external power.

Battery Switch.

The battery switch (figure 1-22) (not in rear cockpit) is a two-position switch marked BATTERY and OFF. The BATTERY (or ON) position connects the aircraft's battery to the DC primary power through a relay which obtains its power directly from the battery. Approximately 18 volts are required to close the relay which will remain closed down to approximately seven volts. Unless approximately 18 volts are available from the battery, the relay will not close. When the battery switch is in the OFF position, without the engine operating, DC primary power can be energized only when a DC external power source is connected to the aircraft.

DC and AC ELECTRIC POWER SUPPLY control panel

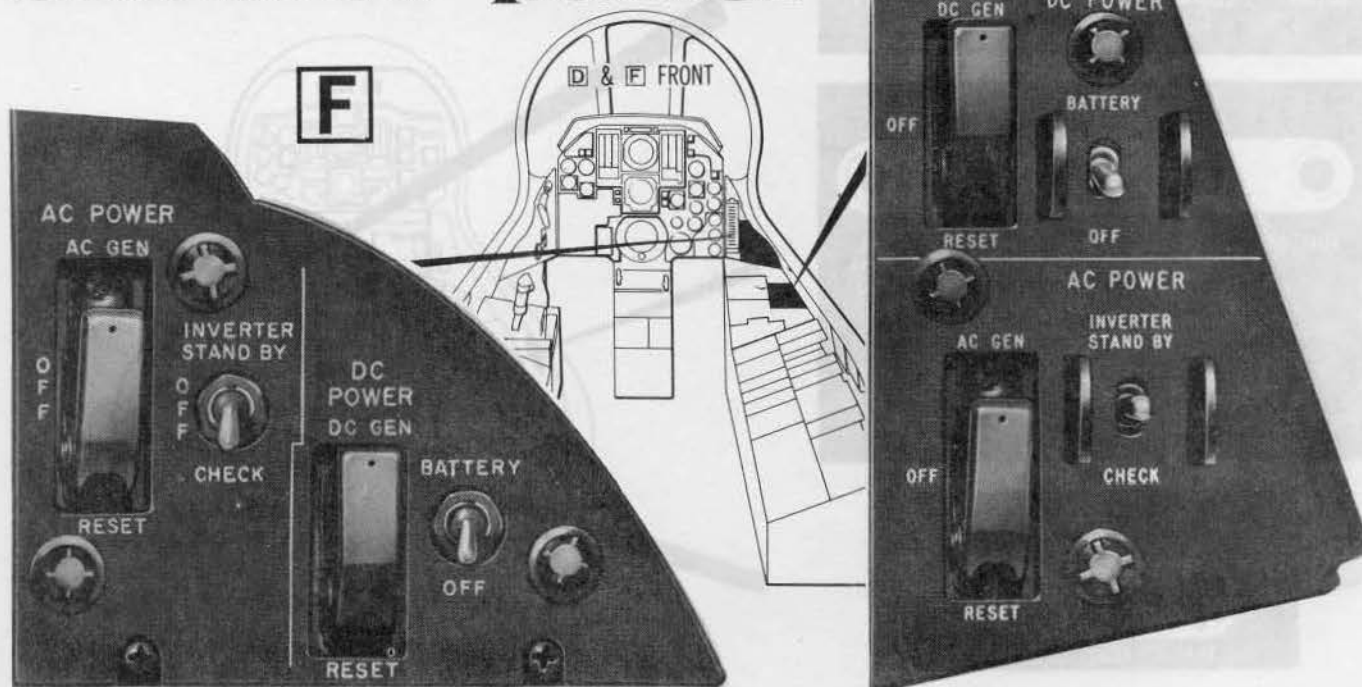


Figure 1-22

CAUTION

To assure maximum service life of the aircraft battery, it must not be charged at too high a rate. Therefore, to prevent the possibility of overcharging due to faulty regulation on the service unit, the battery switch should be in the OFF position when DC external power is connected.

DC Generator Switch.

The DC generator switch (figure 1-22) (not in rear cockpit) has three positions placarded DC GEN, (ON), OFF, and RESET and is guarded in the DC GEN or ON position. The DC GEN position connects the generator to the electrical system whenever the generator voltage is sufficient to close the main contactor relay. The OFF position disconnects the generator from the electrical system. Holding the switch momentarily in the RESET position and then placing it in DC GEN resets the generator field

control relay. The DC generator control circuit is powered by DC primary power.

DC Generator Caution Light.

The DC generator caution light (figure 1-60) located on the caution light panel displays DC GEN and is powered by DC primary power. Whenever the main contactor relay opens, the generator caution light will illuminate, together with the master caution light, indicating that the generator is disconnected from the electrical system.

Battery High Charge Caution Light [955] C/W.

The battery high charge caution light (5A, figure 1-7) is a yellow press-to-test light powered by DC primary power and placarded BAT HIGH CHARGE when illuminated. Illumination of the light after a predetermined delay indicates that the battery charging current is excessive. The time delay is necessary to avoid nuisance illumination of the light caused by a momentary surge of current. Subjecting the battery to a prolonged high charging rate will cause battery damage and/or failure. To protect the battery from

a high charging rate the battery switch should be turned off in which case the caution light will go out. The light can be dimmed by the warning and caution lights switch.

Battery High Voltage Light [955] C/W.

The battery high voltage light (5A, figure 1-7) is a yellow press-to-test light powered by DC primary power and placarded BAT HIGH VOLT when illuminated. Illumination of the light after a predetermined time delay indicates that the battery charging voltage is excessive. The time delay is necessary to avoid nuisance illumination of the light caused by momentary high voltage. Subjecting the battery to a prolonged high voltage charge will cause battery damage and/or failure. To protect the battery from high voltage the battery switch should be turned off in which case the caution light will remain illuminated. The light can be dimmed by the warning and caution lights switch.

EXTERNAL POWER RECEPTACLES.

External power receptacles (figure 1-78) are provided so that both the DC and the AC primary and secondary circuits can be energized by an external power source when the engine is inoperative. If an AC external power source is not available, AC primary power can be energized by using the DC external power and the standby inverter. The AC secondary power cannot be energized unless an AC external power source is available.

ALTERNATING CURRENT SYSTEM.

The AC power supply system (figure 1-20) is powered by a three-phase 115/200-volt, 400-cycle generator. Both the generator and the utility hydraulic pump are driven by an air turbine motor (ATM) which utilizes air from the engine compressor. In normal operation the AC generator distributes power through a two-bus system, identified as the primary power and the secondary power. The primary power includes the instrument power which has its voltage reduced to 26 volts by a step down transformer. The main AC circuit breaker disconnects the generator from the system when an over-voltage (132 to 134 volts for 10 seconds) or under-voltage (95 to 102 volts) condition exists, external ground supplied AC power is connected, or the AC GEN switch is positioned to OFF. A standby inverter, powered by DC primary power, is provided to supply AC primary power when the AC generator is inoperative.

Air Turbine Switch.

Refer to "Air Turbine Motor" in this section.

AC Generator Switch.

The AC generator switch (figure 1-22) (not in rear cockpit) is a three-position toggle switch with positions AC GEN (ON), OFF and RESET and is guarded in the AC GEN (ON) position. The OFF position opens the main AC circuit breaker disconnecting the generator from the electrical system. The RESET position resets the main AC circuit breaker, and the ON position resets the generator field control relay.

Note

Due to design of the AC power system, the AC generator switch must be placed first in the RESET position and then in the AC GEN position each time that the air turbine motor is started to assure AC power being supplied to the AC primary and secondary circuits.

Inverter Switch.

The inverter switch (figure 1-22) (not in rear cockpit) is placarded INVERTER, and has three positions: STANDBY, OFF, and CHECK. The OFF position is unmarked on  aircraft. The STANDBY position must be selected to supply AC primary power to the electrical system when the AC generator is operating or when starting the engine with or without an AC external power source. The STANDBY position also completes a circuit to supply DC primary power automatically to operate the standby inverter if AC power from the generator fails. The OFF position disconnects AC primary power from either the AC generator or the standby inverter and prevents DC power from being supplied to operate the inverter. In the OFF position the AC GEN & INV caution light will illuminate; however, AC secondary power will be energized if the AC generator is operating. In the CHECK position, power from the generator to AC primary power is cut off and the DC power is supplied to operate the standby inverter which, in turn, energizes AC primary power. At the same time, the generator continues to energize AC secondary power. The switch returns automatically from CHECK to OFF position when released.

Note

The ADI and HSI are subject to oscillations when the inverter switch is held

Note (Continued)

in the CHECK position while the AC generator is operating.

AC Generator Caution Light.

The AC generator caution light (figure 1-60), located on the caution light panel, displays AC GEN and is powered by DC primary power. Illumination of the light indicates AC secondary power is deenergized.

AC Generator and Inverter Caution Light.

The AC generator and inverter caution light (figure 1-60), located on the caution light panel, displays AC GEN AND INVTR and is powered by DC primary power. With the inverter switch in STANDBY, illumination of the light indicates both AC primary and AC secondary power is not available. The light will also illuminate if the inverter switch is in the OFF position.

AIR TURBINE MOTOR (ATM).

The air turbine motor (ATM) (figure 1-23) provides a constant speed drive for the AC generator and the utility hydraulic system pump. The ATM is driven by air pressure supplied by the last stage of the engine compressor through a pressure regulating and shutoff valve. The shutoff valve is controlled by a switch in the cockpit. The ATM includes a speed regulating system that provides the constant turbine speed required for generator frequency control. Air pressure supplied to the speed regulating system is stabilized by an air reservoir and check valve which prevents ATM shutdown from momentary interruptions of the air supply caused by certain maneuvers or gun gas ingestion.

CAUTION

The ATM compartment will not be used for storage purposes. Serious consequences can develop if this area is utilized as a storage area.

Note

The air turbine motor (ATM) will not operate when the main hot air line shutoff valve switch is OFF.

Air Turbine Switch.

The air turbine switch (3, figure 1-7) (not in rear cockpit) powered by DC primary power is a

three-position switch placarded AIR TURBINE with positions marked START and STOP, and is spring loaded to an unmarked neutral position. The START position opens the pressure regulating valve in the air line from the engine which supplies compressed air to operate the ATM. The switch must be held in the START position until the utility system pressure stabilizes at normal operating pressure. A holding relay then maintains the pressure regulating valve in the open position as long as operation is normal. The STOP position closes the pressure regulating valve, thereby stopping the supply of air to the ATM and rendering it inoperative. If DC primary power fails, the pressure regulating valve in the compressed air line will remain open and the ATM will be operative. However, if DC power is restored the valve will close and the ATM will have to be restarted.

Note

If the DC generator is inoperative and the battery switch is turned OFF, the ATM will stop when the battery switch is returned to the ON position. Therefore the ATM switch should be held to the START position when returning the battery switch to ON.

HOT AIR LINE OVERHEAT INDICATING SYSTEM.

The hot air line overheat indicating system detects and indicates leakage anywhere in the hot air line from the main air line shutoff valve at the engine 15th stage compressor main air bleed manifold to the ATM, heating, pressurization and refrigeration system. The indicating system has two sensor loops and two indicator lights and a test switch to check operation of the entire system. One sensor loop senses hot air leakage between the ATM pressure regulator/shutoff valve and the ATM, and the other sensor loop senses hot air leakage between the main air line shutoff valve and the ATM pressure regulator/shutoff valve. The system requires AC and DC primary power for operation.

ATM Air Line Overheat Caution Light.

The ATM air line overheat caution light (figure 1-60) on the right auxiliary panel of the , and the right console of the  displays ATM AIR LINE O'HEAT and is powered by DC primary power through the HOT AIR BLEED WARNING DC circuit breaker. Illumination of the light indicates that temperature adjacent to the hot air line between the ATM pressure regulator shutoff valve and the ATM exceeds approximately 204°C (400°F). A sensing element

ATM SYSTEM (air turbine motor)

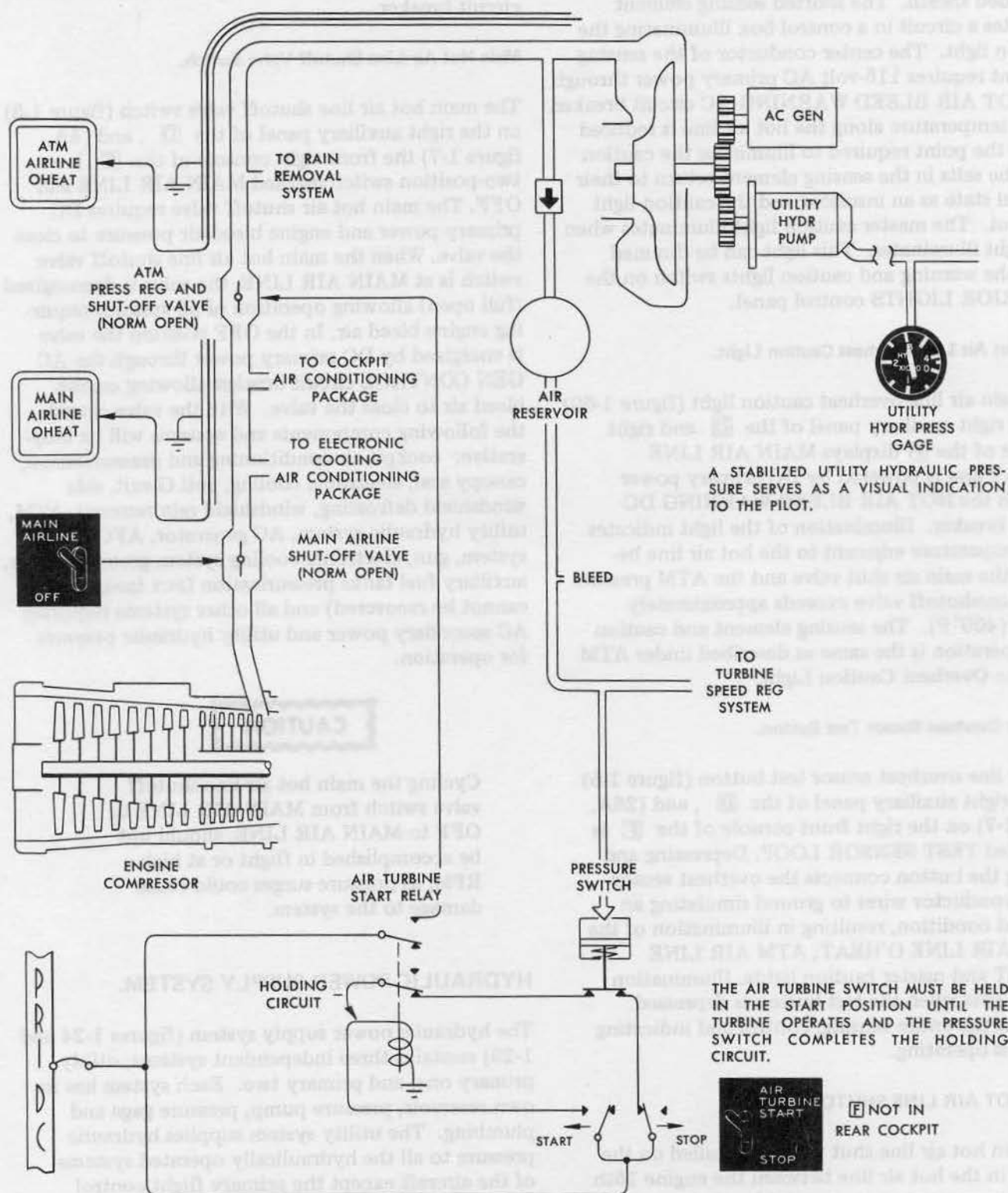


Figure 1-23

loop consisting of a wire insulated from an outer grounded metal sheath by eutectic salts is installed along the entire length of the hot air line. When temperature anywhere along the hot air line is excessive and the salts in that portion of the sensing element melt and short the center conductor to the grounded sheath. The shorted sensing element activates a circuit in a control box illuminating the caution light. The center conductor of the sensing element requires 115-volt AC primary power through the HOT AIR BLEED WARNING AC circuit breaker. When temperature along the hot air line is reduced below the point required to illuminate the caution light the salts in the sensing element return to their original state as an insulator and the caution light goes out. The master caution light illuminates when this light illuminates. This light can be dimmed using the warning and caution lights switch on the INTERIOR LIGHTS control panel.

Main Hot Air Line Overheat Caution Light.

The main air line overheat caution light (figure 1-60) on the right auxiliary panel of the  and right console of the  displays MAIN AIR LINE O'HEAT and is powered by DC primary power through the HOT AIR BLEED WARNING DC circuit breaker. Illumination of the light indicates that temperature adjacent to the hot air line between the main air shut valve and the ATM pressure regulator/shutoff valve exceeds approximately 204°C (400°F). The sensing element and caution light operation is the same as described under ATM Air Line Overheat Caution Light.

Air Line Overheat Sensor Test Button.

The air line overheat sensor test button (figure 1-5) on the right auxiliary panel of the  , and (26A, figure 1-7) on the right front console of the  is placarded TEST SENSOR LOOP. Depressing and holding the button connects the overheat sensor center conductor wires to ground simulating an overheat condition, resulting in illumination of the MAIN AIR LINE O'HEAT, ATM AIR LINE O'HEAT and master caution lights. Illumination of the lights when the test button is depressed indicates the entire sensing, control and indicating system is operating.

MAIN HOT AIR LINE SHUTOFF VALVE.

The main hot air line shut valve is installed on the aircraft in the hot air line between the engine 15th stage compressor hot air manifold and all systems requiring engine bleed air for operation. The valve

is controlled by a switch and is normally in the open (deenergized position). DC primary power and engine air are required to close the valve in the event of excessive temperature adjacent in the hot air line from the valve to the ATM pressure regulator shutoff valve. The valve is powered through the AC GEN CONTROL circuit breaker.

Main Hot Air Line Shutoff Valve Switch.

The main hot air line shutoff valve switch (figure 1-5) on the right auxiliary panel of the , and (4A, figure 1-7) the front right console of the  is a two-position switch marked MAIN AIR LINE and OFF. The main hot air shutoff valve requires DC primary power and engine bleed air pressure to close the valve. When the main hot air line shutoff valve switch is at MAIN AIR LINE, the valve is deenergized (full open) allowing operation of all systems requiring engine bleed air. In the OFF position the valve is energized by DC primary power through the AC GEN CONTROL circuit breaker allowing engine bleed air to close the valve. With the valve closed the following components and systems will be inoperative: cockpit air conditioning and pressurization, canopy seal, electronic cooling, anti G-suit, side windshield defrosting, windshield rain removal, ATM, utility hydraulic system, AC generator, AFCS, VAI system, gun, electronic cooling system ground blower, auxiliary fuel tanks pressurization (aux tanks fuel cannot be recovered) and all other systems requiring AC secondary power and utility hydraulic pressure for operation.

CAUTION

Cycling the main hot air line shutoff valve switch from MAIN AIR LINE to OFF to MAIN AIR LINE, should not be accomplished in flight or at high RPM, as pressure surges could cause damage to the system.

HYDRAULIC POWER SUPPLY SYSTEM.

The hydraulic power supply system (figures 1-24 and 1-25) contains three independent systems; utility, primary one, and primary two. Each system has its own reservoir, pressure pump, pressure gage and plumbing. The utility system supplies hydraulic pressure to all the hydraulically operated systems of the aircraft except the primary flight control systems. The primary one and primary two systems each operate one side of the tandem actuators for

the ailerons, spoilers, stabilizer, rudder and a control stick boost. An emergency hydraulic system is provided to supply hydraulic power to the primary flight controls in the event of engine failure. The emergency system consists of a ram air turbine (RAT), hydraulic pump, and transfer valves, and utilizes the utility system reservoir to provide hydraulic fluid under pressure to the primary one system.

UTILITY HYDRAULIC SYSTEM.

The utility hydraulic system (figure 1-24) supplies hydraulic pressure to operate the landing gear, leading edge flaps, speed brake, refueling probe and receptacle, bomb bay doors, nose wheel steering, wheel brakes, variable air inlet system, the gun drive and water injection. Utility system pressure is maintained by a variable displacement pump driven by an air turbine motor (ATM). The air turbine motor, which is driven by air from the engine compressor, also drives the AC generator. An airless, positive displacement type reservoir maintains the necessary supply of fluid to the pump. Volumetric changes within the reservoirs are small during operation of any of the systems. The utility system pressurizes the emergency hydraulic system accumulator, which immediately provides fluid under pressure to extend the RAT when the emergency system is selected and the RAT pump has not had time to build up pressure. A test valve is provided in the line between the utility pressure and emergency pressure systems so that utility pressure can be shut off and the emergency pressure system pump output pressure can be checked.

Air Turbine Switch.

Refer to "Air Turbine Switch" in this section.

Hydraulic Pressure Gage (Utility).

The utility hydraulic pressure gage (16, figure 1-3), powered by single-phase, 26-volt, AC, primary power, is placarded UTILITY and indicates pressure output of the utility hydraulic pump in PSI. If AC primary power should fail the pressure gage may continue to indicate the same pressure reading that was on the gage at the time of electrical power failure or the reading may go to zero or stop at some intermediate position. One noticeable indication that will appear after AC power failure is that hydraulically actuated units will operate normally but the gage will not fluctuate during the actuation of the system.

PRIMARY HYDRAULIC SYSTEMS.

Refer to "Flight Control System" in this section.

EMERGENCY HYDRAULIC SYSTEM.

Refer to "Flight Control System" in this section.

FLIGHT CONTROL SYSTEM.

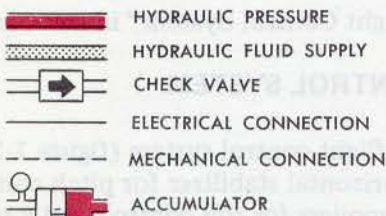
The primary flight control system (figure 1-25) uses a movable horizontal stabilizer for pitch control, ailerons and spoilers for roll control, and a rudder for yaw control. The control surfaces are operated by hydraulic tandem actuators, each powered by both the primary one and primary two hydraulic systems for normal operation. If either of the primary hydraulic systems fails, control of the aircraft is maintained by pressure supplied by the other. If both primary hydraulic systems fail, as in the case of engine flameout control of the aircraft may be maintained by manually extending the ram air turbine (RAT) to supply emergency hydraulic pressure to the primary one hydraulic system. When operating the controls with a hydraulic pump failure, the rate of roll or rate of pitch change may be affected. Air loads are not transmitted back through the controls and therefore "feel" is provided by artificial feel devices, in each primary control, which in combination with electric actuators, are also used for trimming the aircraft about the three axes. When the pilot trims the aircraft, electric actuators adjust the feel devices to a new neutral or "no-load" position. Force may be trimmed to zero within the range of approximately one-half total surface deflection. A pitch mechanical advantage shifter, rudder stops, and aileron lockouts incorporated in the control systems to compensate for varying conditions of speed and altitude, are described under applicable headings. An automatic flight control system (AFCS) is incorporated with each primary control to provide the AFCS function of stab aug (stability augmentation) and pilot relief. An AFCS emergency disconnect level, which disengages all AFCS equipment including stab aug, is provided on the forward side of the control stick just below the stick grip. Automatic flight control system operation and associated controls are fully described in this section. Secondary flight controls include the leading edge and trailing edge flap systems which are described in subsequent paragraphs.

PRIMARY HYDRAULIC SYSTEMS.

The primary hydraulic systems (figure 1-25) are two individual systems, designated as the primary one on

UTILITY HYDRAULIC SYSTEM

CODE



CAUTION AND INDICATING LIGHTS SHOWN ILLUMINATED FOR INFORMATION ONLY

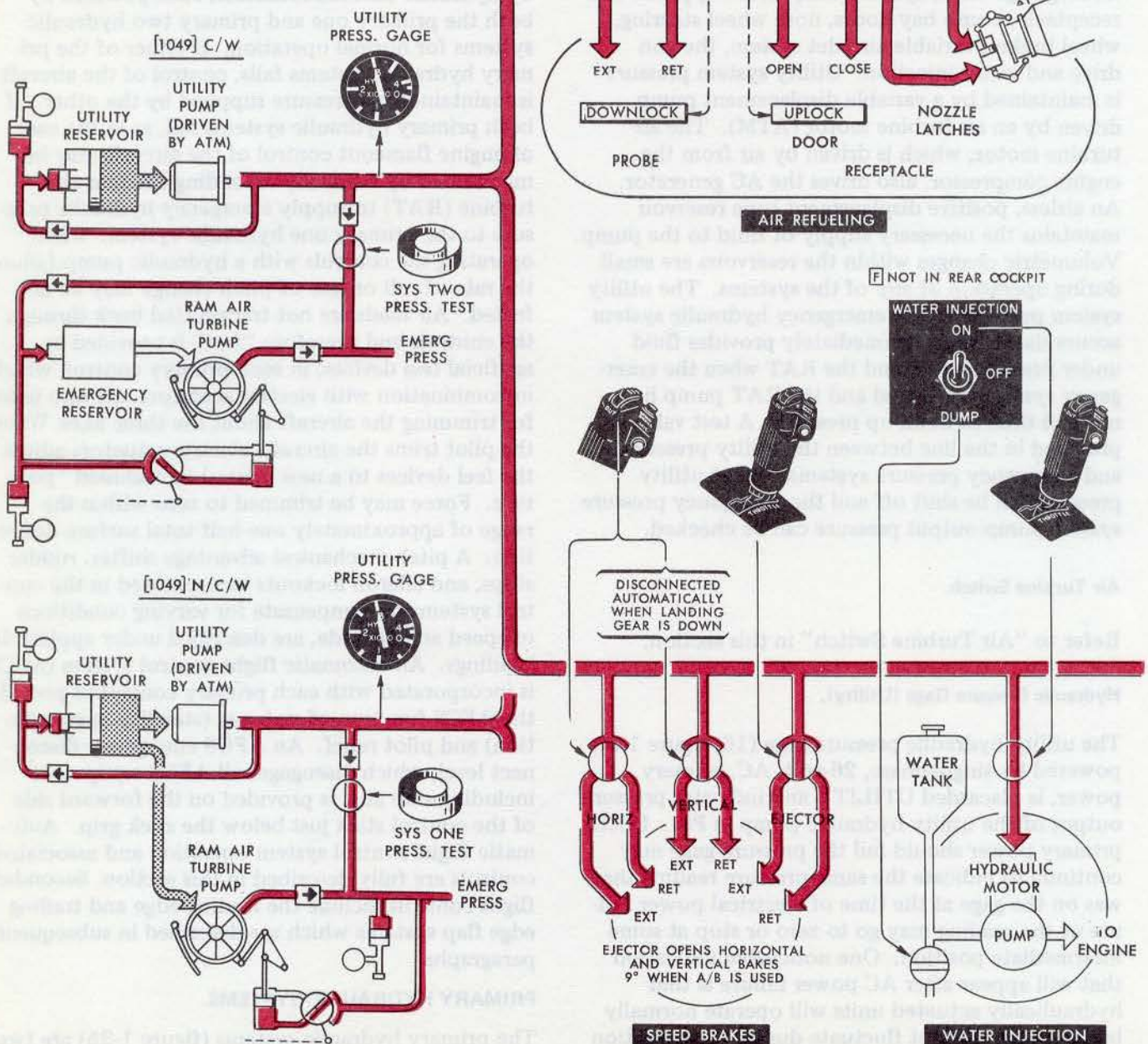


Figure 1-24 (Sheet 1 of 2)

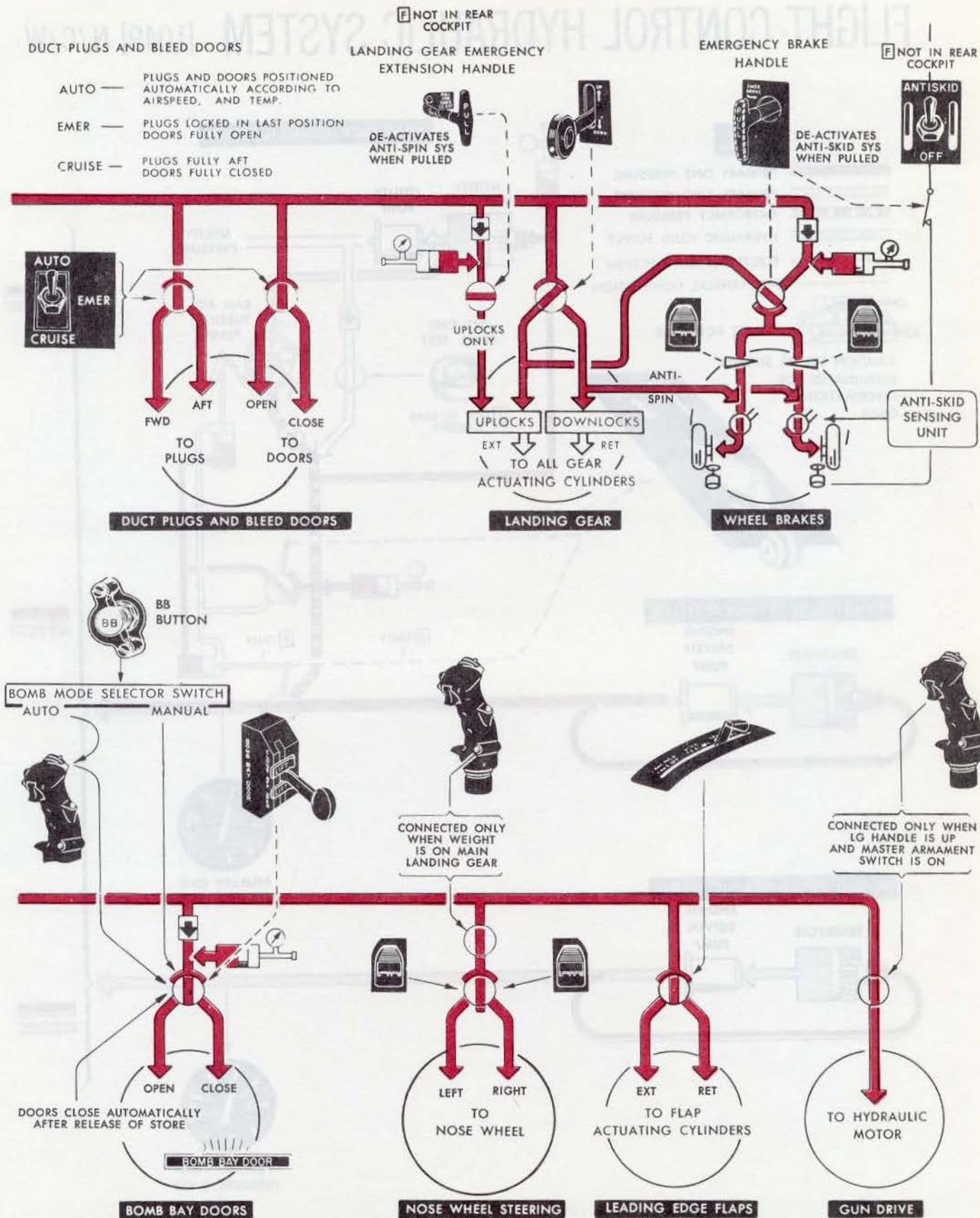


Figure 1-24 (Sheet 2 of 2)

FLIGHT CONTROL HYDRAULIC SYSTEM [1049] N/C/W

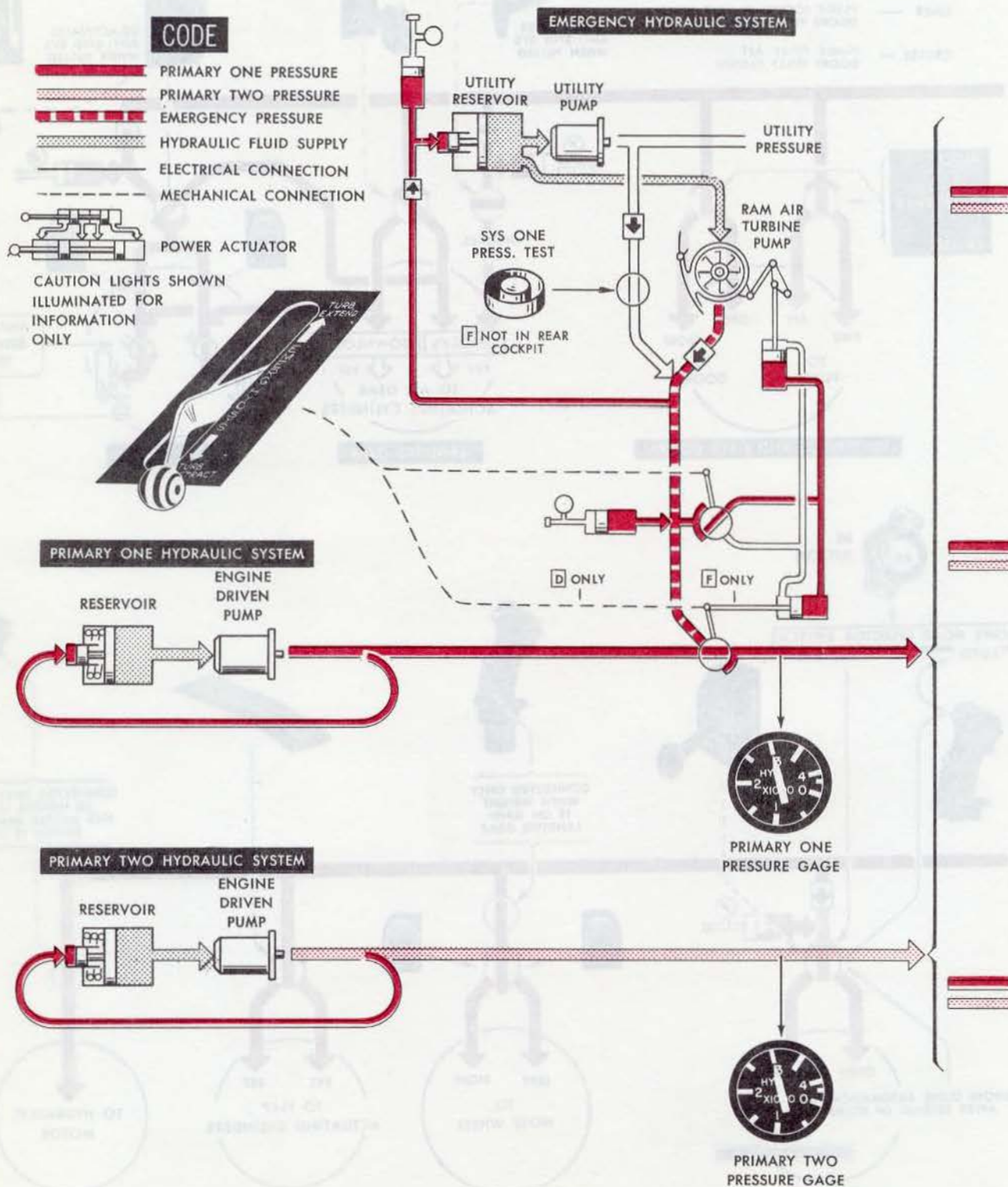


Figure 1-25 (Sheet 1 of 2)

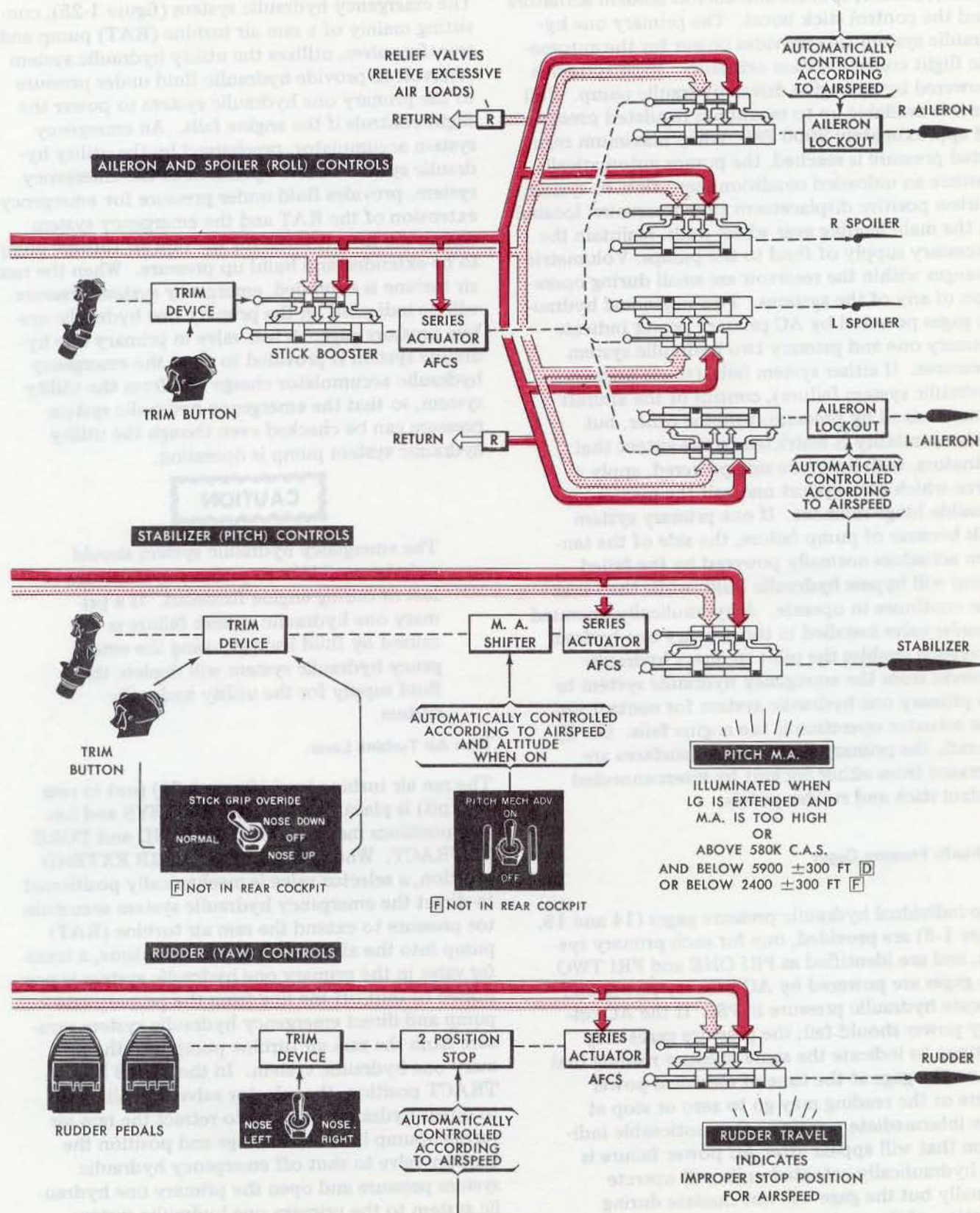


Figure 1-25 (Sheet 2 of 2)

the left side of the aircraft, and primary two on the right side. Each system powers one side of the stabilizer, rudder, spoilers and aileron tandem actuators and the control stick boost. The primary one hydraulic system also provides power for the automatic flight control system actuators. Each system is powered by an engine driven hydraulic pump. Full flow is available up to maximum regulated pressure of approximately 3000 PSI. When maximum regulated pressure is reached, the pumps automatically assume an unloaded condition (zero flow to system). Airless positive displacement type reservoirs, located in the main landing gear wheel wells, maintain the necessary supply of fluid to the pumps. Volumetric changes within the reservoir are small during operation of any of the systems. Two individual hydraulic gages powered by AC primary power indicate primary one and primary two hydraulic system pressures. If either system fails, (single primary hydraulic system failure), control of the aircraft is maintained by pressure from the other, but maneuverability is restricted to the extent that actuators, with only one side powered, apply a force which can support one-half the maximum possible hinge moment. If one primary system fails because of pump failure, the side of the tandem actuators normally powered by the failed pump will bypass hydraulic fluid, while the other side continues to operate. A hydraulically operated transfer valve installed in the primary one hydraulic system enables the pilot to direct hydraulic pressure from the emergency hydraulic system to the primary one hydraulic system for control surface actuator operation if the engine fails. On **F** aircraft, the primary flight control surfaces are operated from either cockpit by interconnected control stick and rudder pedals.

Hydraulic Pressure Gages.

Two individual hydraulic pressure gages (14 and 15, figure 1-3) are provided, one for each primary system, and are identified as PRI ONE and PRI TWO. The gages are powered by AC primary power and indicate hydraulic pressure in PSI. If the AC primary power should fail, the pressure gages may continue to indicate the same pressure reading that was on the gage at the time of electrical power failure or the reading may go to zero or stop at some intermediate position. One noticeable indication that will appear after AC power failure is that hydraulically actuated units will operate normally but the gage will not fluctuate during actuation of the system.

EMERGENCY HYDRAULIC SYSTEM.

The emergency hydraulic system (figure 1-25), consisting mainly of a ram air turbine (RAT) pump and transfer valves, utilizes the utility hydraulic system reservoir to provide hydraulic fluid under pressure to the primary one hydraulic system to power the flight controls if the engine fails. An emergency system accumulator, precharged by the utility hydraulic system before operation of the emergency system, provides fluid under pressure for emergency extension of the RAT and the emergency system during the time it takes for the ram air turbine pump to be extended and build up pressure. When the ram air turbine is extended, emergency system pressure will be indicated on the primary one hydraulic system pressure gage. A test valve in primary one hydraulic system is provided to close the emergency hydraulic accumulator charge line from the utility system, so that the emergency hydraulic system pressure can be checked even though the utility hydraulic system pump is operating.

CAUTION

The emergency hydraulic system should only be used if both primary systems are lost or during engine flameout. If a primary one hydraulic system failure is caused by fluid leakage, using the emergency hydraulic system will deplete the fluid supply for the utility hydraulic system.

Ram Air Turbine Lever.

The ram air turbine lever (figure 1-28) (not in rear cockpit) is placarded EMERG HYD SYS and has two positions marked TURB EXTEND and TURB RETRACT. When placed in the TURB EXTEND position, a selector valve is mechanically positioned to direct the emergency hydraulic system accumulator pressure to extend the ram air turbine (RAT) pump into the airstream. At the same time, a transfer valve in the primary one hydraulic system is positioned to shut off the line from the primary one pump and direct emergency hydraulic system pressure from the ram air turbine pump into the primary one hydraulic system. In the TURB RETRACT position, the selector valve is positioned to direct hydraulic pressure to retract the ram air turbine pump into the fuselage and position the transfer valve to shut off emergency hydraulic system pressure and open the primary one hydraulic system to the primary one hydraulic system pump.

WARNING

During operational checks or emergency use of the emergency hydraulic system, the ram air turbine lever shall be moved to the full TURB EXTEND or TURB RETRACT position with no hesitation in the mid travel area. There shall be no control movement during RAT lever movement.

- In event of control movement, during RAT lever motion, which may cause increased lever resistance, the RAT lever motion shall be continued forcefully without hesitation or returned to its original position. The RAT lever shall not be allowed to remain in an intermediate position.

Aircraft Configuration	Stabilizer Lock Capability	Differential Flap Capability	Dual Flap Indicator	Third Emergency Hydraulic System
1045 NCW 1049 NCW	NO	NO	NO	NO
1045 CW	YES	YES	NO	YES
1045 CW 1049 CW	YES	YES	YES	YES
1045 CW 1049 CW 1091 CW	NO	NO	YES	NO
1045 CW 1049 NCW 1091 CW	NO	NO	NO	NO

System Pressure Test Button.

1049 N/C/W

The system one pressure test button (figure 1-28) (not in rear cockpit) on the flight control panel is placarded SYSTEM ONE PRESS TO TEST. Depressing the button, when the ram air turbine is extended and the aircraft is on the ground, enables the pilot to read the pressure of the emergency hydraulic system accumulator on the primary one hydraulic system pressure gage if utility hydraulic pressure does not dissipate too rapidly. Depressing the button when the ram air turbine is extended during flight enables the pilot to read the pressure of the emergency hydraulic system (RAT pump) which may indicate up to 3700 PSI. When the button is depressed, DC primary current closes a two-position, normally open, solenoid valve in the pressure line from the utility hydraulic system, through which the emergency system accumulator is normally charged. This prevents utility hydraulic system pressure from being indicated on the primary one hydraulic system pressure gage when the ram air turbine lever is in the TURB EXTEND position. Releasing the button deenergizes the solenoid valve and the valve opens permitting utility hydraulic system pressure to enter the emergency hydraulic system to maintain full pressure in the emergency hydraulic system accumulator.

1049 C/W

The system pressure test button (figure 1-28) (not in the rear cockpit) on the right control panel is placarded "SYSTEM TWO PRESS TO TEST". The operation of the test button is the same with the aircraft recovery system installed except that the pressure of the Emergency Hydraulic System Accumulator is read on the Primary Two Hydraulic System Pressure Gage (figure 1-26).

PITCH CONTROL SYSTEM.

A maneuvering stabilizer is provided to effect pitch

control through the speed range. The stabilizer control system consists of a combination of push pull rods and dual cables, pilot operated by fore and aft motion of the control stick. The control movement passes through the feel device, a non-linear linkage and a mechanical advantage shifter, which changes the stick-stabilizer travel ratio automatically to compensate for different conditions of airspeed and altitude. In general, large control surface deflections are required for control at higher altitudes and all speeds, as well as at low altitudes and low speeds, such as during takeoff and landing. This is obtained by the small mechanical advantage ratios with 1:1 M.A. giving the greatest surface deflection per inch of stick travel. For low altitude, high speed flight, small surface deflections per inch of stick travel, required for control of the aircraft, are obtained by a shift of mechanical advantage toward a higher value. M A ratio for the **D** and **F** aircraft are as follows:

*Max stabilizer L. E. travel
with stick at neutral trim.*

Min M A ratio D & F	1:1 25.0 deg down 7.0 deg up
Max M A ratio F	1.53:1 20.1 deg down 5.3 deg up
Max M A ratio D	1.67:1 15.4 deg down 4.8 deg up

A self-contained magnetic stick damper is incorporated in the system to reduce any pilot tendency to over-control by preventing excessively rapid stick motions. The damping rate of the stick damper is fixed. Excessively rapid stick motions are also limited by the bottoming of the control valve when they reach the equivalent of the maximum available pump capacity for the hydraulic actuator. The non-linear link in the control system reduces the stick sensitivity around neutral in any trimmed position. The pitch control system is part of the automatic flight control system.

Control Stick.

The conventional control stick is connected (by push-pull rods and cable assemblies) to hydraulic control valves at the roll and pitch control actuators. Movement of the stick positions these control valves so that pressure from the primary one and primary two hydraulic systems is directed to the actuators to move the control surfaces. A follow-up system automatically closes the control valves when the desired movement of the control surfaces has been obtained. A stick grip (figure 1-27) is mounted on an adapter which houses two pitch and two roll force switches that sense pressure applied to the stick grip. There is a slight movement between the grip and the control stick due to the force switches. These force switches permit the pilot, at any time, to interrupt any mode of automatic flight control (except stab-aug in pitch control, auto ILS, or Autos

FLIGHT CONTROL HYDRAULIC SYSTEM [1049] C/W

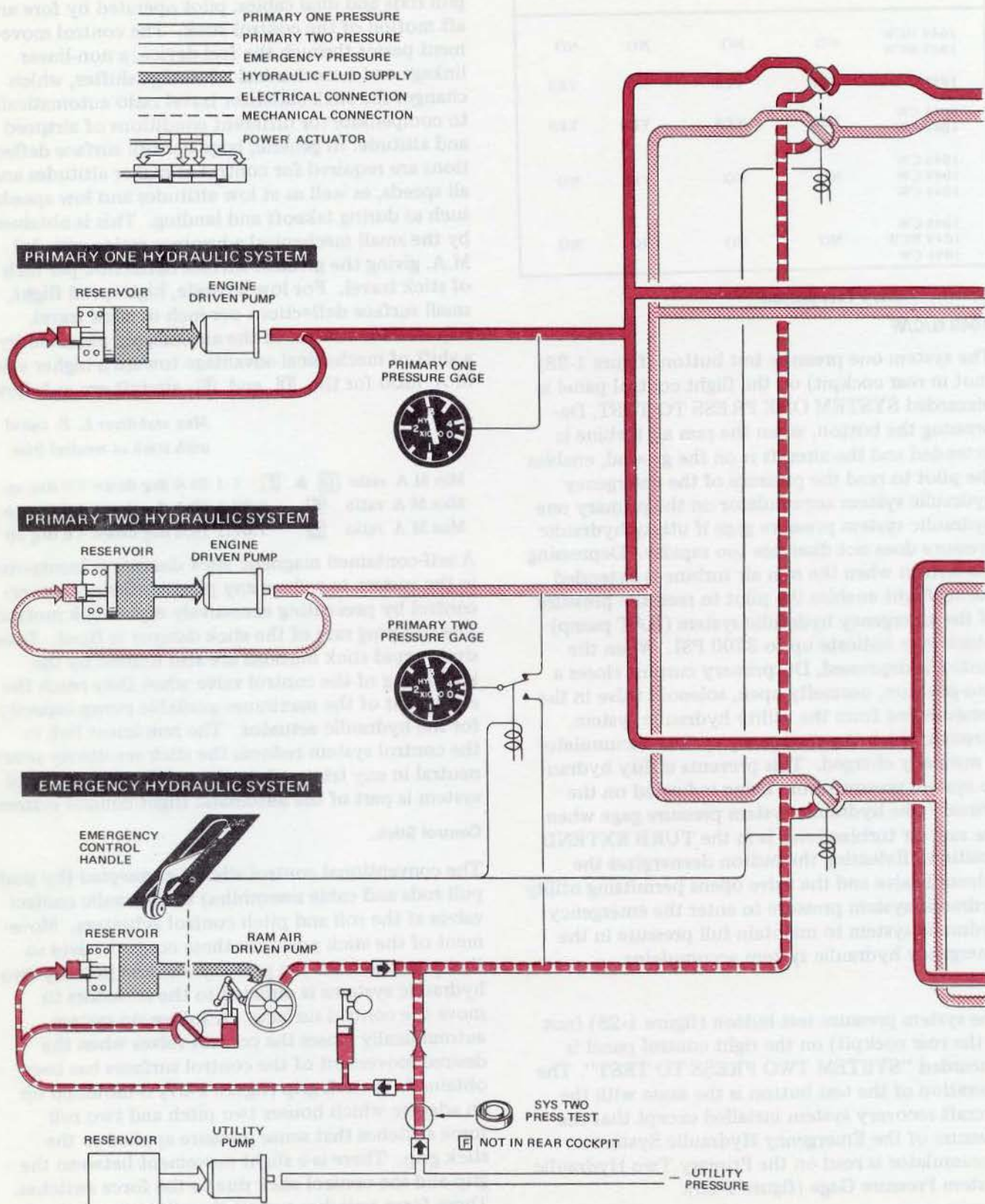


Figure 1-26 (Sheet 1 of 2)

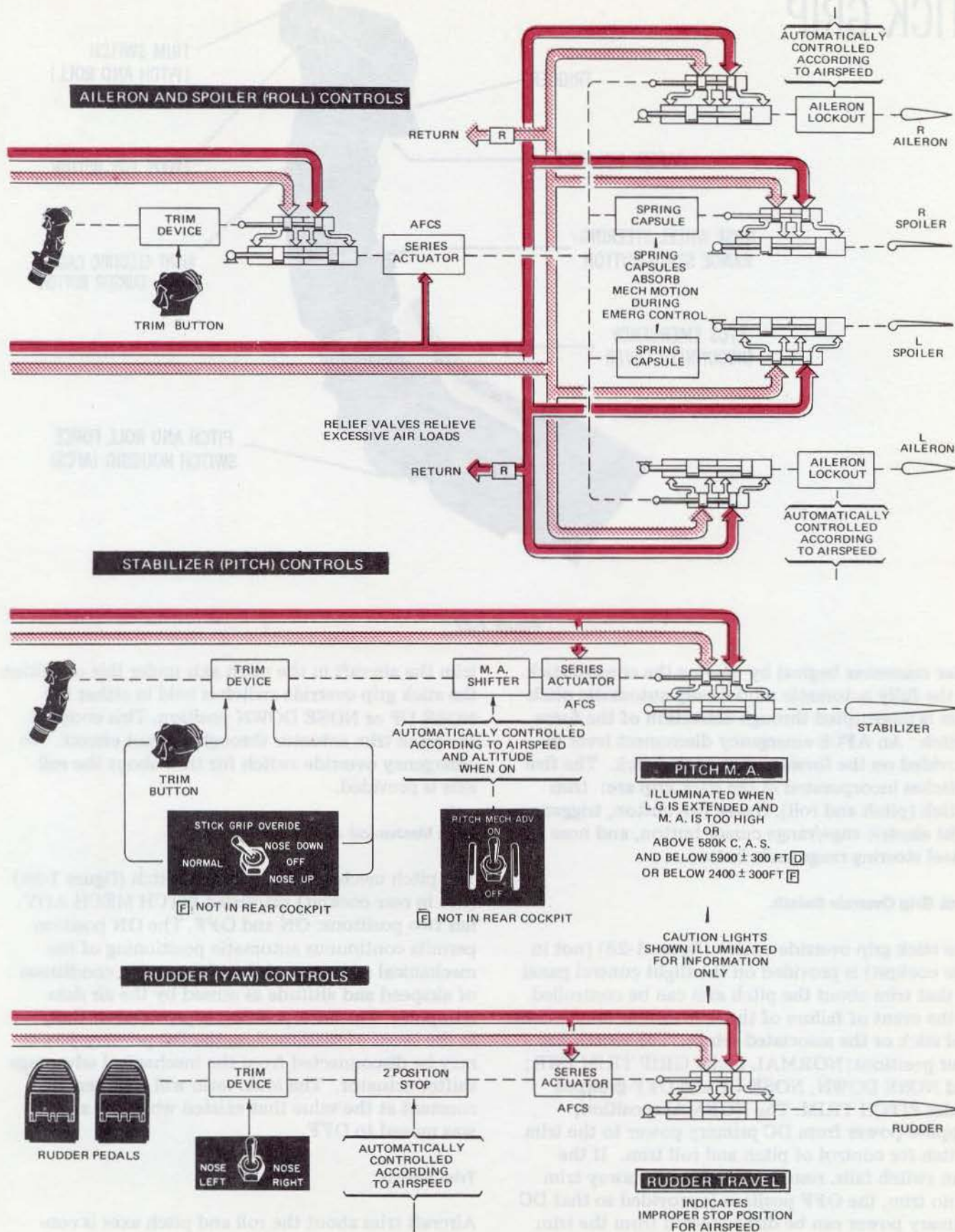


Figure 1-26 (Sheet 2 of 2)

STICK GRIP

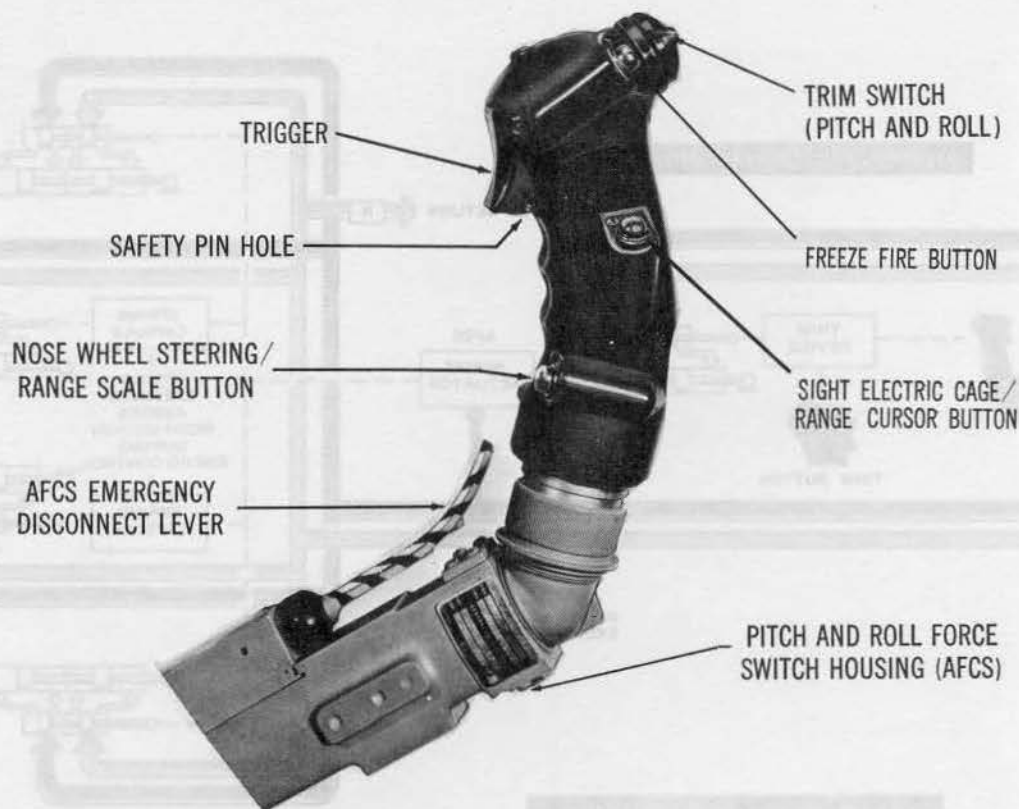


Figure 1-27

after maneuver begins) by moving the control stick. In the fully automatic modes only automatic pitch trim is interrupted through activation of the force switch. An AFCS emergency disconnect lever is provided on the forward side of the stick. The five switches incorporated in the stick grip are: trim switch (pitch and roll), freeze fire button, trigger, sight electric cage/range cursor button, and nose wheel steering range scale button.

Stick Grip Override Switch.

The stick grip override switch (figure 1-28) (not in rear cockpit) is provided on the flight control panel so that trim about the pitch axis can be controlled in the event of failure of the trim switch on the control stick or the associated relays. The switch has four positions; NORMAL under GRIP TRIM PWR; and NOSE DOWN, NOSE UP and OFF grouped under PITCH TRIM. The NORMAL position, supplies power from DC primary power to the trim switch for control of pitch and roll trim. If the trim switch fails, resulting in either runaway trim or no trim, the OFF position is provided so that DC primary power can be disconnected from the trim switch. In this position both pitch and roll trim circuits to the trim switch are disconnected. To

trim the aircraft in the pitch axis under this condition the stick grip override switch is held in either the NOSE UP or NOSE DOWN position. This controls the pitch trim actuator through a direct circuit. No emergency override switch for trim about the roll axis is provided.

Pitch Mechanical Advantage Switch.

The pitch mechanical advantage switch (figure 1-28) (not in rear cockpit) placarded PITCH MECH ADV, has two positions: ON and OFF. The ON position permits continuous automatic positioning of the mechanical advantage shifter for varying conditions of airspeed and altitude as sensed by the air data computer. The OFF position is provided so that, in the event of malfunction, the DC primary power may be disconnected from the mechanical advantage shifter actuator. The M.A. ratio will then remain constant at the value that existed when the switch was moved to OFF.

Trim Switch.

Aircraft trim about the roll and pitch axes is controlled by a five-position trim switch (figure 1-27) on the stick grip which is spring-loaded to the OFF

FLIGHT CONTROLS panel TYPICAL

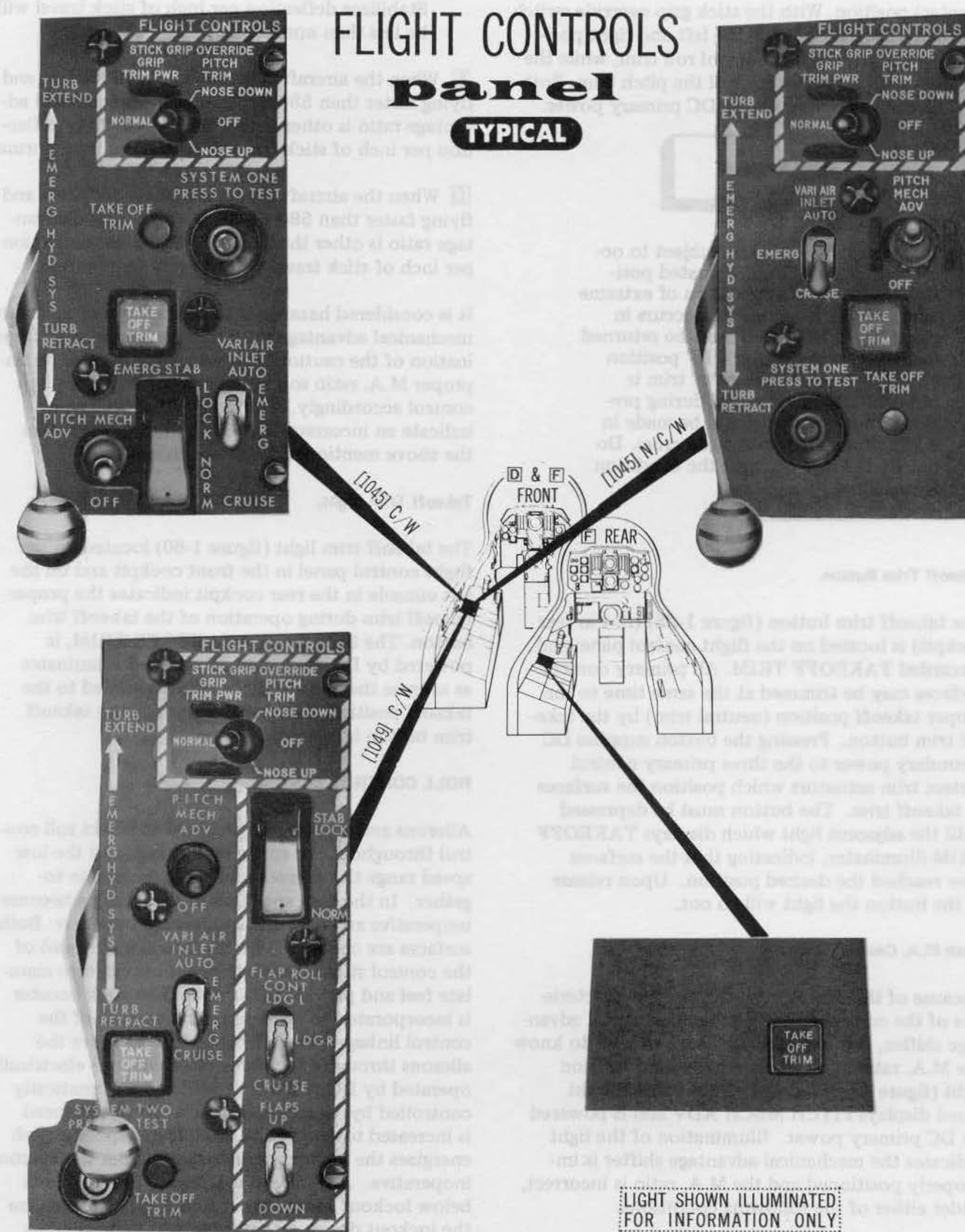


Figure 1-28

(center) position. With the stick grip override switch in the NORMAL position, the left and right positions of the trim switch control roll trim, while the up and down positions control the pitch trim. Both trim circuits are energized by DC primary power.

WARNING

The trim switch may be subject to occasional sticking in an actuated position, resulting in application of extreme trim. When this condition occurs in flight, the trim switch must be returned manually to the center OFF position after the desired amount of trim is obtained. If this is noted during pre-flight check, entry should be made in AFTO Form 781 with a red cross. Do not fly the aircraft until the condition is corrected.

Takeoff Trim Button.

The takeoff trim button (figure 1-28) (not in rear cockpit) is located on the flight control panel and placarded TAKEOFF TRIM. All primary control surfaces may be trimmed at the same time to the proper takeoff position (neutral trim) by the takeoff trim button. Pressing the button supplies DC secondary power to the three primary control system trim actuators which position the surfaces to takeoff trim. The button must be depressed until the adjacent light which displays TAKEOFF TRIM illuminates, indicating that the surfaces have reached the desired position. Upon release of the button the light will go out.

Pitch M.A. Caution Light.

Because of the completely automatic characteristics of the continuously variable mechanical advantage shifter, it is not necessary for the pilot to know the M.A. ratio at all times. However, a caution light (figure 1-60) located on the caution light panel displays PITCH MECH ADV and is powered by DC primary power. Illumination of the light indicates the mechanical advantage shifter is improperly positioned and the M.A. ratio is incorrect, under either of the following conditions:

- When the landing gear is extended and the mechanical advantage ratio is other than 1:1.

Stabilizer deflection per inch of stick travel will be less than normal.

Ⓔ When the aircraft is below 2400 (± 300) feet and flying faster than 580 KCAS and the mechanical advantage ratio is other than 1.53:1. Stabilizer deflection per inch of stick travel will be more than normal.

Ⓕ When the aircraft is below 5900 (± 300) feet and flying faster than 580 KCAS the mechanical advantage ratio is other than 1.67:1. Stabilizer deflection per inch of stick travel will be more than normal.

It is considered hazardous to be unaware of incorrect mechanical advantage ratio in such conditions. Illumination of the caution light warns the pilot of an improper M.A. ratio so that he can compensate pitch control accordingly. The caution light does not indicate an incorrect M.A. ratio during other than the above mentioned flight conditions.

Takeoff Trim Light.

The takeoff trim light (figure 1-60) located on the flight control panel in the front cockpit and on the left console in the rear cockpit indicates the proper takeoff trim during operation of the takeoff trim button. The light displays TAKEOFF TRIM, is powered by DC secondary power, and illuminates as soon as the control surfaces are trimmed to the takeoff position, and remains lit until the takeoff trim button is released.

ROLL CONTROL SYSTEM.

Ailerons and spoilers are provided to effect roll control throughout the entire speed range. In the low speed range the ailerons and spoilers operate together. In the high speed range the ailerons become inoperative and only the spoilers are operative. Both surfaces are controlled by the lateral movement of the control stick. A feel device is provided to simulate feel and provide trim. A tandem stick booster is incorporated to assist in the movement of the control linkage. The aileron actuators move the ailerons through a lockout device which is electrically operated by DC primary power, and automatically controlled by an airspeed switch. As the airspeed is increased to 695 (± 5) KCAS, the airspeed switch energizes the lockout actuators to render the ailerons inoperative. As airspeed is reduced 7 to 13 knots below lockout speed, the switch will again energize the lockout device actuators to make the ailerons operative again. The feel trim actuator is electrically heated to prevent stick bind due to ice formation

in the feel trim actuator. The roll control system is part of the automatic flight control system.

YAW CONTROL SYSTEM.

The rudder is provided to effect yaw control throughout the speed range. Rudder pedal motion operates a slide valve that controls a tandem actuator at the rudder. An artificial feel unit is incorporated in the control system to give the pilot a sense of control feel, by increasing the force required to deflect the controls proportional to the amount of deflection. Yaw trim is accomplished by an electric actuator that changes the position of the feel device no-load position to the desired trim setting. A full automatic two-position rudder stop is installed to reduce both rudder surface and rudder pedal travel at high speed to prevent structural overloads. On increasing speed at approximately 275 KCAS, a solenoid, energized by DC primary power through the airspeed switch, positions the high speed stop to restrict rudder travel to 8 degrees left or right, also reducing rudder pedal travel. When speed is reduced below approximately 260 KCAS, the solenoid is deenergized and spring action retracts the high speed stop, permitting the full 32 degrees left and 32 degrees right rudder travel. If the TE FLAP circuit breaker is disengaged the rudder stop will be inoperative above 275 KCAS. A caution light on the caution panel illuminates whenever the rudder stop position is not compatible with the airspeed switch. The yaw control system is part of the automatic flight control system.

WARNING

If the airspeed sensing switch fails above 275 KCAS the rudder stops will not retract and the rudder travel caution light will not illuminate.

Rudder Pedals.

The rudder pedals are mounted to carriage assemblies which ride on rails in the cockpit as the pedals are actuated. A spring-loaded lever on the outboard side of each carriage incorporates a pawl which engages in notches in a bar. The nine numbered notches in the bar provide for individual adjustment of each pedal over a distance of approximately 6½ inches. Coordinated pedal alignment during adjustment is obtained by engaging the spring-loaded lever on each pedal in a corresponding number notch on each bar. The pedals are pivot mounted

at the lower end to permit rotary motion for power brake action. The nose wheel steering system is operated by rudder pedal movement. (Refer to "Nose Wheel Steering System" in this section.) Rudder pedal movement operates a valve which controls a tandem actuator at the rudder. A follow-up system automatically closes the control valve when the desired movement has been obtained. Force switches incorporated in each rudder pedal permit the pilot to interrupt the heading hold and track hold modes of AFCS operation, and when actuated, prevent engagement of NAV hold mode or initiation of autoss or auto wings level.

Yaw Trim Switch.

The yaw trim switch (figure 1-11) is a three-position switch, spring-loaded to a neutral OFF position. Holding the switch to NOSE LEFT or NOSE RIGHT completes a DC primary circuit to the rudder trim actuator which repositions the rudder feel device to relieve the rudder pedal force at the desired rudder trim.

Rudder Travel Caution Light.

The rudder travel caution light (figure 1-60) on the caution light panel displays RUDDER TRAVEL and is powered by DC primary power. Illumination of the light indicates the two-position rudder stop is in an incorrect position in relation to airspeed. The light will illuminate if the rudder travel is restricted in the low speed range, or not restricted in the high speed range.

AUTOPILOT EMERGENCY DISCONNECT LEVERS.

The autopilot emergency disconnect lever (figure 1-27) on the control stick disconnects electric power for all modes of automatic flight control system operation (including stab-aug).

EMERGENCY FLIGHT CONTROL SYSTEM [1045] C/W.

The purpose of this emergency flight control system is to provide limited flight control to enable a pilot to reach a safe bail out area in event of complete hydraulic system failure. This is accomplished by providing a limited degree of control about the three aircraft axes. With the stabilizer locked at a predetermined position, pitch control is maintained by using trailing edge flaps and engine thrust. Lateral and directional control is maintained by using differential trailing edge flaps, unboosted rudder or both. The locked stabilizer position (approximately

EMERGENCY FLIGHT CONTROLS

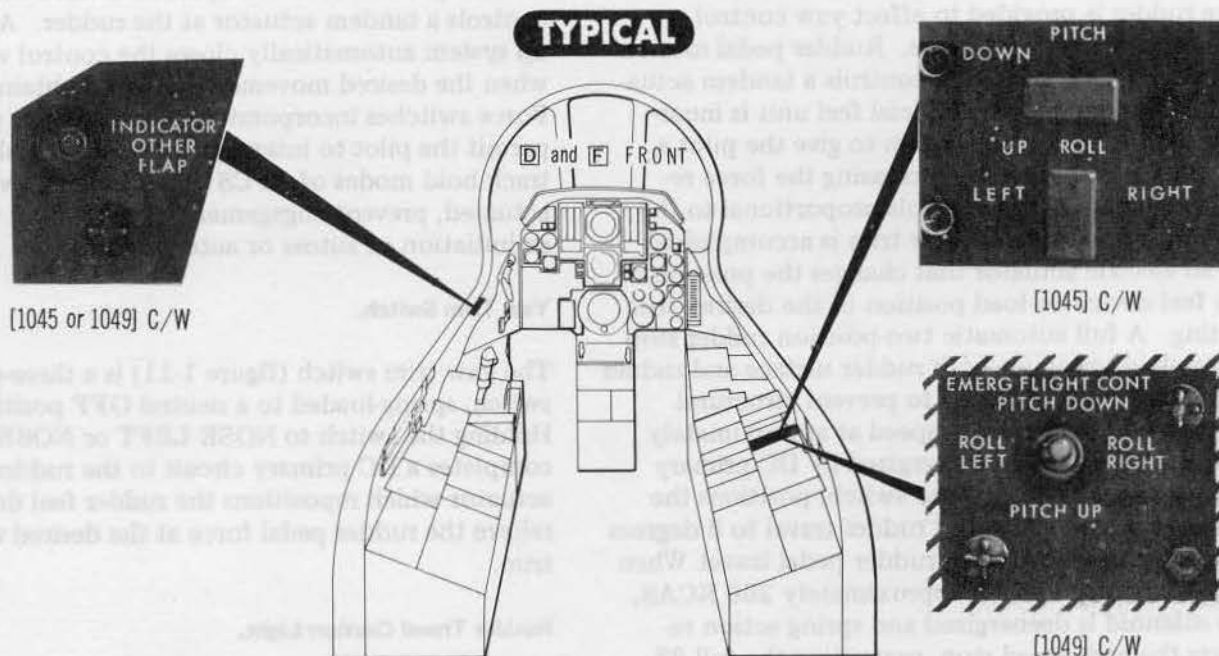


Figure 1-29

1.8 degrees for F-105D and 2.3 degrees for F-105F leading edge down) will trim the *clean* aircraft at approximately 350 knots and 10,000 feet altitude for an average gross weight and center of gravity. Increasing engine thrust will cause a nose up trim change and will rotate the nose of the aircraft up and the excess thrust will produce a climb. Deflecting the trailing edge flaps will rotate the nose of the aircraft down and the combination of engine thrust and trailing edge flaps can stabilize the aircraft at constant altitudes and at speeds higher than 350 knots. Speed at a given altitude is a function of engine thrust and trailing edge flap deflection.

Roll control is initially accomplished by use of rudder and differential trailing edge flap extension. After the aircraft is stabilized, rudder is used as the primary roll control and differential trailing edge flap extension is used for roll trim. Differential flaps should be limited to trim control since failure of the flap system may leave the aircraft in an uncontrollable condition. There is adequate yaw and roll control with the unboosted rudder. Satisfactory control can be maintained between 350 KIAS and a Mach No. of 0.85 from sea level to 20,000 feet altitude. Satisfactory flight control in this case means the ability to select and maintain

moderate but not necessarily precise attitude (pitch, roll, yaw), altitude control and direction of flight.

The stabilizer should be locked when the aircraft is in a 10- to 15-degree nose up attitude in the speed range between 350 KIAS and 0.85 Mach up to 20,000 feet altitude. However, lock engagements can be performed beyond this envelope, even at supersonic speeds, if required, but the aircraft must be in a 10- to 15-degree nose up attitude when the stabilizer is locked. If the stabilizer is locked outside the recommended locked stabilizer speed range, the speed should be reduced to the recommended values as soon as possible. The most easily handled altitude and speed is 10,000 feet between 380 and 420 KIAS.

WARNING

Locking of the stabilizer during flight for reasons other than an actual emergency condition is strictly *prohibited*. Simulation of the emergency condition is only to be performed as prescribed in the TRAINING INSTRUCTIONS. A

WARNING (Continued)

thorough understanding of the emergency flight control system is required to permit safe operation during an emergency.

- Due to structural considerations flap extension is limited to 30 percent of maximum deflection for speeds up to 0.85 Mach when the emergency flight control system is utilized. The use of conventional lateral control (aileron and spoilers) with flaps extended 30 percent at 0.85 Mach the flaps are loaded close to maximum design allowable and the use of conventional lateral control will add to this critical loading.

CAUTION

The aircraft is sensitive in roll when the differential flaps are used. Only instant switch actuation is necessary for roll response.

Note

All engagements of the stabilizer lock should be performed in a 10- to 15-degree nose up attitude.

- At no time should the nose of the aircraft be allowed to fall through the horizon after the stabilizer has been locked.
- All airspeeds for use of the emergency control system are given in KIAS, which is the reading on the standby airspeed indicator. Due to the possibility of damage to the CADC system, or interruption of secondary AC power, it is recommended that the standby indicator be utilized rather than the AMI for airspeed readings.

Stabilizer Lock Switch [1045] C/W.

The stabilizer lock switch (figure 1-28) located on the left console is placarded EMERG STAB with two positions, NORM and LOCK. In the NORM position the stabilizer and flap control systems operate in the normal manner. The LOCK position energizes the stabilizer lock, transfers trailing edge flap operation from the flap level on the throttle

quadrant to the emergency roll and pitch control switches and illuminates the stabilizer lock light. When the LOCK position is selected, the control stick is moved toward neutral until lock engagement is felt. The switch is powered by the DC primary bus.

Emergency Pitch Control Switch [1045] C/W.

The emergency pitch control switch (figure 1-29) located on the right console, is a three position momentary contact switch placarded PITCH with positions UP, DOWN and unmarked OFF position. With the stabilizer lock switch in the LOCK position, holding the switch in the UP or DOWN position will retract or extend the flaps respectively for pitch control of the aircraft. Direction of the switch actuation corresponds to conventional control stick motion. Extending the flaps (switch forward) will lower the nose of the aircraft. The switch is powered by the DC primary bus.

Emergency Roll Control Switch [1045] C/W.

The emergency roll control switch (figure 1-29) located on the right console, is a three-position momentary contact switch placarded ROLL with positions LEFT, RIGHT and an unmarked OFF position. With the stabilizer lock switch in the LOCK position the LEFT or RIGHT position of the roll control switch is used for differential flap operation. The LEFT position will lower the right flap and raise the left flap effecting a roll to the left. The RIGHT position will effect a roll to the right. The switch is powered by DC primary power.

Other Flap Indicator Switch [1045] C/W.

The other flap indicator switch (figure 1-29) located on the left side windshield fitting is placarded INDICATOR OTHER FLAP. The flap position indicator will normally display the position of the lower flap. Depressing the other flap indicator switch will enable monitoring the other flap position.

Stabilizer Lock Light [1045] C/W.

The red stabilizer lock light (figure 1-60) is located on the upper center of the instrument panel. When the light is illuminated it displays STAB LOCK and indicates that the stabilizer lock switch is in the LOCK position and/or the system has been energized and is capable of locking the stabilizer. Restricted stick movement, however, is the only positive indicator that the stabilizer is locked or unlocked.

EMERGENCY FLIGHT CONTROL SYSTEM**[1049] C/W.**

T.O. 1F-105D/F-1049 provided an aircraft recovery system to allow the F-105D/F aircraft to be safely controlled and landed following a complete failure of the primary flight control hydraulic system. This new capability is accomplished by providing ram air turbine hydraulic pressure to the P2 portions of the existing stabilizer and rudder actuators and to the P1 and P2 portions of the roll stick boost cylinder when the aircraft recovery mode is selected. Power is supplied by using the present RAT system with the addition of a new reservoir in the nose wheel well. Stabilizer and rudder operation, for aircraft control in the pitch and yaw axes, will be the same as when only P2 pressure is available due to P1 system failure. Lateral control in this mode, however, differs significantly in that no hydraulic pressure is provided to the aileron or spoiler power actuators. The ailerons will deflect with operation of the stick boost actuator with the unpressurized aileron actuators serving as mechanical links. Response of the spoilers is eliminated by deflection of a spring-loaded arm installed in each lost-motion drum.

The emergency flight control system provides aircraft control in event of failure of both primary flight control hydraulic systems. Two emergency modes of operation are provided: the pilot recovery mode and the aircraft recovery mode. The pilot recovery mode provides sufficient aircraft control without hydraulic pressure to allow the pilot to reach a safe bailout area. The aircraft recovery mode utilizes an emergency hydraulic system which provides the capability to fly and land the aircraft safely.

Pilot Recovery Mode [1049] C/W.

During pilot recovery operation the stabilizer is locked at a predetermined position and pitch control is maintained by trailing edge flap position and engine thrust. Lateral and directional control are maintained by using differential trailing edge flaps, unboosted rudder or both. The flap lever on the throttle quadrant is inoperative during emergency flight control system operation. Satisfactory control can be maintained between 350 KIAS and Mach number 0.85 from sea level to 20,000 feet altitude. Satisfactory flight control in this case means the ability to select and maintain moderate but not necessarily precise attitude (pitch, roll, yaw), altitude control, and direction of flight.

Trailing Edge Flap Control – Pilot Recovery Mode**[1049] C/W.**

During pilot recovery mode of operation trailing edge flap control is transferred from the flap lever on the throttle quadrant to the emergency pitch and roll switch on the right console and to the flap roll control switch and flap switch on the left console. Both flaps can be extended or retracted simultaneously by actuating the emergency pitch and roll switch to the pitch positions. The emergency pitch and roll switch provides differential flap control when actuated to the roll positions. During differential flap operation one flap will extend or retract to its limit before the opposite flap moves in the opposite direction. The flap roll control switch permits selection of the opposite flap in the event of failure of the selected flap motor. The flap switch will be utilized for aircraft recovery mode only. The automatic flap blow back control is inoperative during either pilot recovery or aircraft recovery modes of operation.

Engagement – Pilot Recovery Mode [1049] C/W.

The stabilizer should be locked when the aircraft is in a 10- to 15-degree nose-up attitude in the speed range between 350 KIAS and Mach 0.85 up to 20,000 feet altitude. Lock engagements can be performed beyond this envelope, even at supersonic speeds if required, but the aircraft must be in a 10- to 15-degree nose-up attitude when the stabilizer is locked. If the stabilizer is locked outside of the recommended locked stabilizer speed range the speed should be reduced to the recommended values as soon as possible. The most comfortable control is achieved at 10,000 feet between 380 and 420 KIAS.

Pitch Control – Pilot Recovery Mode [1049] C/W.

The locked stabilizer position (leading edge down approximately 1.8 degrees for [D] and 2.3 degrees for [E]) will trim the clean aircraft at approximately 350 knots and 10,000 feet altitude for an average gross weight and center of gravity. Increasing engine thrust will cause a nose-up trim change which will rotate the nose of the aircraft up and the excess thrust will produce a climb. Extending the trailing edge flaps will cause a nose-down trim change which will rotate the nose of the aircraft down. The coordinated selection of flap position and engine thrust can stabilize the aircraft at a constant altitude at speeds higher than 350 knots. Speed at a given altitude is a function of engine thrust and trailing edge flap deflection.

Roll Control -- Pilot Recovery Mode [1049] C/W.**WARNING**

■ Roll control is initially achieved by use of unboosted rudder and differential trailing edge flap deflection. After the aircraft is stabilized the unboosted rudder is used as the primary roll control and differential flap operation is used for roll trim.

Yaw Control -- Pilot Recovery Mode [1049] C/W.

Adequate yaw control is available with the unboosted rudder. The automatic rudder stops are inoperative.

Locking of the stabilizer during flight for reasons other than an actual emergency condition is strictly prohibited. Simulation of the emergency condition

WARNING (Continued)

is only to be performed as prescribed in the TRAINING INSTRUCTIONS. A thorough understanding of the emergency flight control system is required to permit safe operation during an emergency.

- Due to structural considerations, flap extension is limited to 30 percent (10 degrees) of maximum deflection for speeds up to Mach 0.85 when the emergency flight control system is utilized. During training missions the use of conventional lateral control (aileron and spoilers) with flaps extended should be minimized. With flaps extended 30 percent at 0.85 Mach, the flaps are loaded close to maximum design allowable and the use of conventional lateral control will add to this critical loading.

CAUTION

The aircraft is sensitive in roll when the differential flaps are used. Only momentary switch actuation is necessary for roll response.

Note

All engagements of the stabilizer lock should be performed in a 10- to 15-degree nose-up attitude.

- At no time should the nose of the aircraft be allowed to fall through the horizon after the stabilizer has been locked.
- All airspeeds for use of the emergency control system are given in KIAS, which is the reading on the standby airspeed indicator. Due to the possibility of damage to the CADC system, or interruption of secondary AC power, it is recommended that the standby indicator be utilized rather than the AMI for airspeed readings.

Aircraft Recovery Mode [1049] C/W.

The aircraft recovery mode is selected by extending the RAT. When the RAT is extended, emergency hydraulic pressure is supplied to the system No. 2 portion of the stabilizer and rudder actuators and to the system Nos. 1 and 2 portions of the stick boost actuator. Emergency pressure is not supplied to

aileron or spoiler actuators. Emergency pressure is indicated on the system No. 2 pressure indicator when the RAT is extended. Extension of the RAT will transfer flap control from the flap lever to the emergency system switches.

Trailing Edge Flap Control — Aircraft Recovery Mode [1049] C/W.

Trailing edge flap control is identical to trailing edge flap control when in the pilot recovery mode except when the flap roll control switch is in the CRUISE position. In the CRUISE position, if both flaps are down, they will creep up as demand for roll is made.

Engagement — Aircraft Recovery Mode [1049] C/W.

The aircraft recovery mode is normally employed only after the aircraft attitude has been stabilized using the pilot recovery mode. If the aircraft is not in the correct attitude for the pilot recovery mode engagement when the hydraulic systems fail, the aircraft recovery mode may be employed to provide a nose-up attitude for stabilizer lock engagement.

Note

The aircraft recovery mode is normally employed prior to using the pilot recovery mode. The pilot recovery mode may be employed if failure of the emergency hydraulic system is eminent.

Pitch Control — Aircraft Recovery Mode [1049] C/W.

Emergency hydraulic pressure is supplied to the system No. 2 portion of the dual stabilizer actuator. Normal pitch control will be retained.

Roll Control — Aircraft Recovery Mode [1049] C/W.

Emergency hydraulic pressure is supplied to the stick boost actuator. The ailerons respond directly to stick boost actuator operation with the unpressurized aileron actuators serving as a mechanical link in the controls. The mechanical force to the unpressurized spoiler actuators is absorbed by the modified linkage and the spoilers remain in the retracted position. Normal trim and differential trailing edge flap operation are used for roll trim; however, the aircraft should be trimmed for neutral stick using differential flap operation.

Yaw Control — Aircraft Recovery Mode [1049] C/W.

Emergency hydraulic pressure is supplied to the system No. 2 portion of the dual rudder actuator. Normal yaw control will be retained. The automatic rudder stops are inoperative, permitting operation beyond eight degrees rudder travel.

Emergency Hydraulic System [1049] C/W.

The emergency hydraulic system consists mainly of a ram air turbine (RAT) pump and transfer valves to provide hydraulic fluid under pressure to the primary two hydraulic system to power the stabilizer and rudder actuators and both primary one and two systems of the control stick boost actuator. An emergency system accumulator, precharged by the utility hydraulic system before operation of the emergency system, provides fluid under pressure for extension of the RAT. When the RAT is extended, emergency system pressure will be indicated on the primary two hydraulic system pressure gage. A test valve is provided to close the emergency hydraulic accumulator charge line from the utility system so that the emergency hydraulic system pressure can be checked even though the utility hydraulic system pump is operating.

CAUTION

The emergency hydraulic system should only be used if both primary systems are lost or during engine flameout. If primary two hydraulic system failure is caused by fluid leakage in the aft fuselage area, using the emergency hydraulic system may deplete the fluid supply.

Ram Air Turbine Lever [1049] C/W.

The ram air turbine lever (not in rear cockpit) is placarded EMERG HYD SYS and has two positions marked TURB EXTEND and TURB RETRACT. When placed in the TURB EXTEND position the following occurs:

- A selector valve is mechanically positioned to extend the RAT pump into the airstream.
- A dual transfer valve in the primary two hydraulic system branch at the stabilizer and rudder actuators is positioned to shut off the primary two pressure and return lines and open the emergency hydraulic system pressure and return line to power the stabilizer and rudder actuators from the RAT.
- Transfer valves shut off primary one and primary two system pressure and return lines at the control stick boost actuator and open the emergency hydraulic system lines to power both the primary one and two sides of the actuator from the RAT.

- The aileron and spoiler actuators are isolated from the emergency hydraulic system.
- Roll control is accomplished by use of the trailing edge flaps or lateral movement of the control stick.
- Primary two pressure circuit is transferred to indicate emergency hydraulic system pressure on the primary two pressure gage.
- Flap control is transferred from the flap lever to the emergency system switches.
- Normal pitch and roll trim is maintained.

In the TURB RETRACT position the selector valve is positioned to direct hydraulic pressure to retract the RAT, the dual transfer valves are positioned to direct primary two hydraulic pressure to the primary control actuators, flaps return to normal operation and the primary two pressure gage indicates pressure of the primary two system.

WARNING

During operational checks or emergency use of the emergency hydraulic system, the ram air turbine lever shall be moved to the full TURB EXTEND or TURB RETRACT position with no hesitation in the mid-travel area. There shall be no control movement during RAT lever movement.

- In event of control movement, during RAT lever motion, which may cause increased lever resistance, the RAT lever motion shall be continued forcefully without hesitation or returned to its original position. The RAT lever shall not be allowed to remain in an intermediate position.

System Pressure Test Button [1049] C/W.

The system pressure test button (not in rear cockpit) on the flight control panel is placarded SYSTEM TWO PRESS TO TEST. The button functions in the same manner as in unmodified aircraft except that the emergency hydraulic system pressure is indicated on the primary two hydraulic system pressure gage instead of the primary one gage.

Stabilizer Lock Switch [1049] C/W.

The stabilizer lock switch is a guarded switch with two positions, STAB LOCK and NORM, and is powered by DC primary power. The functions of the switch positions are as follows:

<i>Stab Lock Sw</i>		<i>Stab Actuator Press</i>	<i>Rudder Actuator Press</i>	<i>Ail Actuator Press</i>	<i>Spoil Actuator Press</i>	<i>Control Stick Booster Actuator Press</i>	<i>TE Flaps</i>
NORM	RAT RETRACT	P1 and P2	P1 and P2	P1 and P2	P1 and P2	P1 and P2	Flap control with flap lever on throttle quadrant.
	RAT EXTEND*	Emerg	Emerg	inoper	inoper	Emerg	Flap operation with flap switch, emerg pitch and roll sw and flap roll control sw.
STAB LOCK	RAT RETRACT	Stab locked	inoper	inoper	inoper	inoper	Emerg Pitch and Roll sw, flap roll control sw.
	RAT EXTEND*	Stab locked Emerg	Emerg	inoper	inoper	Emerg	Pitch and roll control with emerg pitch and roll sw. Flap operation with flap sw, emerg pitch and roll sw or flap roll control sw.

*Emergency condition shown. During training, normal P1 pressure will be available to all actuators except stick boost, and normal P2 pressure will be available to the spoiler and aileron actuators.

Flap Roll Control Switch and Emergency Pitch and Roll [1049] C/W.

The flap roll control switch on the left console is a three-position switch placarded FLAP ROLL CONT, with positions marked CRUISE, LDG R, and LDG L. This switch allows the pilot to select either flap for roll control in the event of failure of either flap actuator. The emergency pitch and roll switch located on the right console, is a five-position switch spring-loaded to the OFF position and placarded EMERG FLIGHT CONT. Operational positions are PITCH DOWN, PITCH UP, ROLL LEFT, and ROLL RIGHT. The emergency pitch and roll switch is operable only if DC primary power is available plus one of the conditions below.

Stabilizer lock switch in LOCK position or the RAT extended. Direction of the emergency pitch and roll switch in pitch and roll corresponds to conventional control stick motion. Holding the switch in the PITCH DOWN or PITCH UP position will extend or retract the flaps respectively for pitch control. The ROLL LEFT or ROLL RIGHT posi-

tion is used for differential flap operation for roll control.

Stabilizer lock switch in the LOCK position, the RAT extended, or retracted and the flap roll control switch in LDG R or CRUISE, the right flap will move up or down for roll control. If the right flap reaches either the up or down limit, then the left flap will move (down or up) and hold at the new position. With the flap roll control switch in LDG L the left flap moves up or down for roll control. If the left flap reaches either the up or down limit then the right flap will move (down or up) and hold at the new position.

Stabilizer lock switch in NORM position and the RAT extended. The flap roll control switch placed in LDG R or LDG L the right or left flap respectively will move up or down for roll control. If the flap reaches the up or down limit in either position, the other flap will move (down or up) and hold at the new position. With the flap roll control switch in CRUISE, either left or right flap will move up for roll control. If both flaps are down they will creep up as demand for roll is made.

Other Flap Indicator Switch [1049] C/W.

The other flap indicator switch (figure 1-29) located on the left side windshield fitting is placarded INDICATOR OTHER FLAP. The flap position indicator will normally display the position of the lower flap. Depressing the other flap indicator switch will enable monitoring of the opposite flap position.

Stabilizer Lock Light [1049] C/W.

The red stabilizer lock light (figure 1-60) is located on the upper center of the instrument panel. When the light is illuminated it displays STAB LOCK and indicates that the stabilizer lock switch is in the STAB LOCK position and/or the system has been energized and is capable of locking the stabilizer. Restricted stick movement, however, is the only positive indication that the stabilizer is locked.

Trailing Edge Flaps [1049] C/W.

During normal flap operation on modified aircraft the flap actuators are not mechanically connected but their travel is controlled by a flap synchronizer. If one flap has moved approximately 7 degrees or more than the other flap, it will stop until the other flap reaches the same position; then both flaps will move together. The flap lever is inoperative with the stabilizer lock switch in the STAB LOCK position or if the RAT is extended.

On Aircraft Modified by T.O. 1F-105-1091, the Following Items Have Been Rendered Inoperative:

1. Pitch and Roll Switches (1045 C/W).
2. Emergency Flight Control Pitch and Roll Switch (1049 C/W).
3. Stabilizer Lock Switch (1045 and 1049 C/W).

Because these items are inoperative, the pilot recovery system installed by T.O. 1F-105-1045 and the pilot recovery mode installed by T.O. 1F-105-1049 are no longer available for the pilot's use. In addition, the flap roll control switch and flap switch on the left console are inoperative. Trailing edge flap control is available only through the throttle quadrant flap lever. The interconnecting flexible drive shaft has been reinstalled and individual flap control is no longer available.

With the above exceptions, the aircraft recovery mode (T.O. 1F-105-1049 C/W) is operative. With the RAT extended, P1 and P2 operating, normal P1 pressure will be available to all actuators except the aileron boost, and normal P2 pressure will be available to the spoiler and aileron actuators. RAT pressure will be available to the rudder and stabilizer actuators at the P2 sides and both sides of the aileron boost actuator. No degradation in aircraft control response will be experienced. With single primary hydraulic system failure, either P1 or P2, follow procedures prescribed for this situation in T.O. 1F-105D-1, Section III. With P1 and P2 failure, RAT extended, hydraulic pressure is not available to the spoiler or aileron actuators. Emergency hydraulic pressure will be available to the rudder and stabilizer actuators. There will be appreciable control response degradation at lower airspeeds, especially the ailerons. For this reason, landing with asymmetrical loading, split flaps, gusty winds or any cross wind condition with winds above calm should not be attempted. Recovery at another base with favorable wind conditions should be considered, and if such conditions are not available, the crew should eject rather than attempt to land.

WING FLAP SYSTEMS.**LEADING EDGE FLAPS.**

The leading edge (LE) flaps are full span, extending from the outboard side of each air duct to the inboard side of the wing tip panels. The flaps are designed to increase lift during landing and takeoff, to reduce drag while cruising and improve control during maneuvering flight. When utility hydraulic pressure is applied to the extend side of the actuating cylinder, the resulting lateral piston movement is transmitted to three actuators. As the shafts of the actuators are moved outboard, the actuator assemblies convert the lateral movement to rotary movement of the arm assembly which rotates the attached flap downward. The flaps move through a maximum arc of 20 degrees and require approximately 10 seconds to fully extend or retract. Flap movement is synchronized by flow restrictors in the hydraulic system. Refer to Flight Characteristics, this section, for a more complete explanation of this system.

TRAILING EDGE FLAPS.

The trailing edge (TE) flaps are partial span fowler

type, extending from the inboard end of each wing to the inboard end of the aileron. The flaps have a maximum downward travel of 34.5 degrees. Two mechanically interconnected electric motors powered by DC primary power actuate the flaps. The motors transmit power through individual shafts to gear boxes on a single flexible drive shaft to actuate both flaps by means of screw jacks. If the airspeed exceeds approximately 275 KIAS with the TE flaps extended, an airspeed sensing switch will automatically retract the flaps. On decreasing speed, with the flap lever in LANDING & TAKEOFF, the flaps will extend automatically at approximately 260 KIAS. A fail-safe circuit compares left and right TE flap travel and interrupts power to TE flap motors if flap movement differs by more than approximately 2 degrees during the first third of extension, by more than approximately 7 degrees during the last third of extension and a proportionate amount during the middle third. If flap retraction is interrupted by the fail-safe circuit, the automatic blow-up feature of the trailing edge flaps will be inoperative. The flaps require approximately 7 seconds to fully extend or retract. A ground adjustable trim tab which must not be deflected from the trail position is incorporated as an integral part of the trailing edge flaps on some  aircraft.

Note

If one flap motor fails, TE flaps will extend normally on the ground but will extend slower than normal or not fully extend when in flight. In this event, the flaps will probably fully extend as the aircraft slows to final approach speed.

- If flap operation is suddenly reversed, the current limiting fuses will be overloaded and burned out. Therefore a delay of approximately 5 seconds should be observed when reversing the motion of the flaps.

Flap Lever.

The flap lever (figure 1-11) on the throttle quadrant is placarded FLAPS, and controls the leading edge (LE) and trailing edge (TE) flaps. Four detents are provided in the range of lever travel and are placarded LANDING & TAKEOFF, HOLD T.E. FLAPS, CRUISE & MANUEVER, and L.E. & T.E. FLAPS UP. Both leading and trailing edge flaps are controlled by DC primary power, however the leading edge flaps are actuated by utility hydraulic system pressure. The combined flap configuration obtained in each detent position is as follows:

FLAP LEVER POSITION	FLAP POSITION	
	LE	TE
LANDING & TAKEOFF	100%	100%
HOLD TE FLAPS	100%	AS DESIRED
CRUISE & MANEUVER	40%	0%
LE & TE FLAPS UP	0%	0%

Flap Lever [1045] C/W (D Only).

Control of the TE flaps with the flap lever is deactivated when the pilot recovery system or aircraft recovery system is activated. Control of the LE flaps with the flap lever is unaffected by the pilot recovery system or the aircraft recovery system.

Flap Position Indicator.

The flap position indicator (9, figure 1-6), marked TE, is for trailing edge flaps only. With power available, the pointer continuously indicates the position of the left flap on a scale calibrated in percent of travel. The scale is marked UP and DOWN and has four numbered intermediate positions. The indicator is powered by DC primary power.

Flap Position Indicator [1045] C/W (D Only).

The flap position indicator (9, figure 1-6) indicates the position of the lowest T.E. flap.

SPEED BRAKE SYSTEM.

Each of the four speed brakes consists of a quarter segment attached to two hinge points at the aft end of the fuselage. When closed, the speed brakes are faired to each other and are in contour with the fuselage. Powered by the utility hydraulic system, the brakes are electrically controlled by DC primary power. Speed brake positioning is controlled by the following: a pilot operated switch on the throttle, the position of the landing gear, operation of the throttle to afterburner position and opening of

the engine exhaust nozzle. Provisions are incorporated to automatically retract, or prevent the vertical speed brakes from extending, when the landing gear is extended. This protects the lower speed brake from damage on landing, and prevents interference between the upper speed brake and drag chute during deployment. Mechanical interconnections are not provided for synchronized movement of the speed brake segments. However, the speed brake system is interlocked electrically to the engine exhaust nozzle through the use of a pressure switch to prevent speed brake closure on an open nozzle. A ground test switch is installed inside the aft fuselage, so that all speed brakes can be extended for maintenance purposes.

SPEED BRAKE SWITCH.

The speed brake switch (figure 1-11) powered by DC primary power, is a slide type switch with two placarded positions, IN and OUT, and an unmarked HOLD or neutral position. The switch in the front cockpit is a three-position detented switch, and the switch in the rear cockpit is a three-position momentary switch, spring-loaded to the HOLD or neutral position. The IN position disconnects electrical power from the solenoid control valves, which are spring-loaded to a position to direct utility hydraulic pressure to retract the speed brakes, and the OUT position energizes and positions the same valves to fully extend the brakes. The HOLD position energizes and positions the control valves so that all ports are closed, enabling the pilot to hold the speed brakes in any desired position.

[F] Holding the rear cockpit switch at OUT extends the speed brakes, and if the switch is released before the speed brakes are fully extended they will remain in the position existing at time of switch release provided the front cockpit switch is in the HOLD position. However, if the front cockpit switch is at IN, when the rear switch is released, the speed brakes return to the IN position. When holding the switch at IN, the speed brakes start to close and, if the switch is released, the speed brakes remain at the position existing at time of switch release, if the front switch is at HOLD, otherwise the speed brakes will move to the OUT or IN position last selected by the front crew member. This permits the pilot in the rear cockpit to select any increment of speed brake position from full open to full close. The effect of the landing gear position and afterburner

operation on speed brakes as positioned from either cockpit is shown in the following table:

Speed Brake Switch	LG Position	A/B	Speed Brake Position	
			Vertical	Horizontal
IN	DOWN (Weight on gear)	OFF (Throttle IDLE)	Afterburner 9°	Afterburner 9°
IN	DOWN (Weight on gear)	OFF (Throttle above IDLE)	Closed	Closed
IN	DOWN (Airborne)	OFF	Closed	Closed
IN	DOWN (Airborne)	ON	Afterburner 9°	Afterburner 9°
IN	UP	ON	Afterburner 9°	Afterburner 9°
IN	UP	OFF	Closed	Closed
HOLD	UP	OFF	As desired	As desired
HOLD	DOWN (Airborne)	OFF	Closed	As desired
OUT	DOWN (Airborne)	OFF	Closed	Full open
OUT	UP	OFF	Full open	Full open

Note

- Ⓕ The positions shown are for the front or rear speed brake switch, provided the other cockpit speed brake switch is at HOLD (neutral).
- Ⓕ When the speed brakes are not being used in flight, the speed brake switch in the front cockpit should remain in the IN position. This will prevent speed brake segments from drooping. However, if the rear cockpit requires

speed brake control, the front cockpit should position the speed brake switch to HOLD and return the switch to IN when the rear cockpit no longer needs speed brake control.

LANDING GEAR SYSTEM.

The retractable tricycle landing gear consists of three air oil shock struts together with fairing doors which enclose the struts when the landing gear is retracted. The fairing door remains open when the gear is extended. During normal operation, the landing gear is retracted and extended by utility hydraulic system pressure. Retraction time is approximately 4 to 8 seconds and extension time approximately 5 to 9 seconds. The main gears retract inboard and forward into the lower surface of the wings and the nose gear retracts forward into the fuselage. The main gear is locked up by uplock hooks which engage rollers on the inboard fairing doors. The nose gear is locked up by an uplock hook engaging a roller on the nose gear strut. The uplock hooks are hydraulically actuated and contain an external spring to keep them in the locked position in case of a utility system failure. All gears are locked down by spring-loaded downlocks which are unlocked by hydraulic pressure when the landing gear is retracted. Landing gear position indicators, a red warning light for each gear, and an audible warning signal (beeper), are provided to inform the pilot when the landing gear is in an unsafe position; a green indicator light for each gear is provided to inform the pilot when the landing gear is down and locked.

Inadvertent retraction of the gear, when the aircraft is on the ground, is prevented by a solenoid lock which prevents moving the landing gear handle from the DOWN position. A switch is provided (not in rear cockpit) to override this safety system in emergencies. If the utility hydraulic system fails, an emergency system for lowering the gear is provided. This system unlocks the landing gear uplocks by hydraulic pressure from a manually selected emergency landing gear accumulator and all three struts drop to the down position by gravity in approximately 5 to 13 seconds. The main gear wheels are equipped with hydraulically operated disc brakes. An antiskid system is incorporated to eliminate prolonged tire skidding during landing roll or taxiing. An antispin system automatically applies the brakes during landing gear retraction and prevents fast spinning wheels from throwing debris into main wheel wells. An armament safety circuit is incorporated in the landing gear handle so that electrical

power is disconnected from all armament circuits until the landing gear handle is in the UP position. A nose wheel steering mechanism, incorporated in the nose gear strut, serves as a shimmy damper when the nose wheel steering system is not engaged. Refer to Flight Characteristics, section VI, for pitch trim change during landing gear retraction.

LANDING GEAR GROUND SAFETY PINS.

Ground safety pins (figure 1-29) are provided for each of the landing gear struts. These pins, with attached red warning streamers, are installed when the aircraft is on the ground to prevent inadvertent retraction of the gear. The safety pins must be removed before flight and are normally stowed in a pouch in the nose wheel well.

LANDING GEAR HANDLE.

The landing gear handle (figure 1-5) controls the extension and retraction of the landing gear, and has two positions, UP and DOWN. The handle can only be moved from the DOWN to UP position when battery bus power is available, landing gear struts are in a position from fully extended to approximately 1½ inches compressed, the aircraft is airborne, or the landing gear downlock override switch, (not in rear cockpit) is actuated and held. When the weight of the aircraft is on the struts, and the handle is in the DOWN position, a locking solenoid is de-energized, preventing the handle from being moved from the DOWN position. When the handle is moved to the UP position the landing gear selector valve is mechanically positioned to direct utility hydraulic pressure to unlock the downlocks and retract the struts. The uplocks are sequenced to the locked position when the gears are fully retracted and the fairing doors closed. When the handle is placed in the UP position the landing gear warning light circuit opens the antispin solenoid valve, which directs utility hydraulic pressure from the landing gear up line to the main wheel brakes to stop the wheels from spinning when they retract into the wheel wells. When the landing gear is fully retracted and locked, the warning light in the handle goes out and the antispin solenoid valve closes to relieve hydraulic pressure from the brakes. To move the handle from the UP to the DOWN position, a trigger on the handle must first be actuated to release the spring-loaded lock. When the handle is moved to the DOWN position the landing gear selector valve is mechanically positioned to direct utility hydraulic pressure to unlock the uplocks, extend the gear, and provide power to the brake valves. The spring-

loaded downlocks lock when each strut is fully extended. Hydraulic pressure is maintained in the landing gear system when the struts are extended or retracted. On [E] aircraft, each handle is connected to a control valve by teleflex cables. The movement of one handle results in a corresponding movement of the other handle.

Note

There is no mechanical detent for the down position of the landing gear handle; therefore, an upload should not be applied for a check of the handle down position. With the shock struts compressed the solenoid will lock the handle in the down position.

- If the landing gear is extended by the landing gear emergency extension handle with the landing gear handle in the UP position, wheel brakes will not be available unless the emergency brake handle is pulled.

LANDING GEAR DOWNLOCK OVERRIDE SWITCH.

The landing gear downlock override switch (figure 1-5) (not in rear cockpit), placarded LDG GEAR DOWNLOCK OVERRIDE, will permit the landing gear handle to be moved to the UP position while the aircraft is on the ground and the main gear struts are compressed. If the locking solenoid fails to release the landing gear handle from the DOWN position when the struts are extended, such as after takeoff, the switch can be actuated and held to allow the handle to be placed in the UP position. The switch must be actuated first and held until movement of the landing gear handle has begun and is powered by battery power.

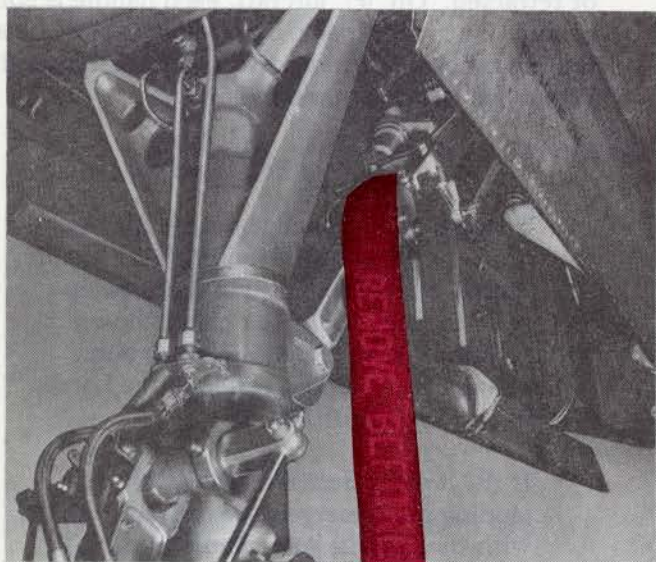
CAUTION

If the main landing gear shock struts are overinflated so as to be in a position of 1½ inches compressed to fully extended, it is possible to move the landing gear handle to the UP position with the aircraft on the ground.

- If pressure is put on the landing gear handle before the switch is actuated the solenoid will bind and will not unlock the handle.

GROUND SAFETY PINS

TYPICAL



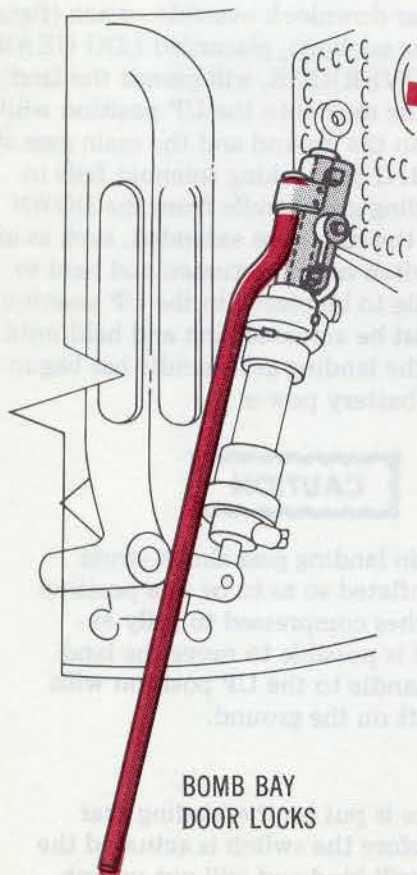
NOSE GEAR DOWNLOCK PIN



REMOVE BEFORE FLIGHT



**DRAG CHUTE
DISARMING PIN**



**BOMB BAY
DOOR LOCKS**



**MAIN GEAR
DOWNLOCK
PINS**



**ARRESTING
HOOK**

Figure 1-30 (Sheet 1 of 2)

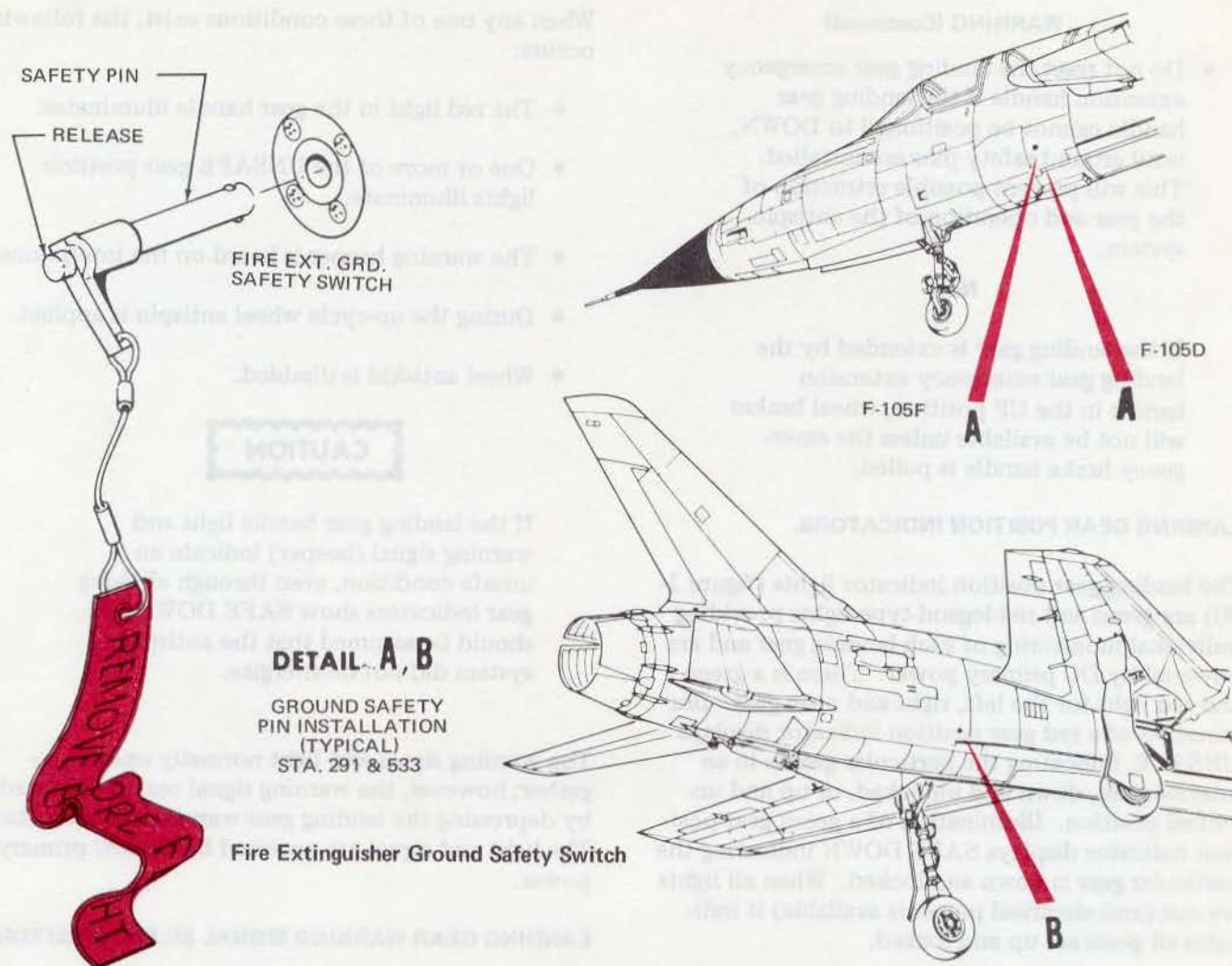


Figure 1-30 (Sheet 2 of 2)

- If the solenoid pin is engaged and the solenoid fails thereafter the gear handle will not go to the UP position.

LANDING GEAR EMERGENCY EXTENSION HANDLE.

The landing gear emergency extension handle (figure 1-5) (not in rear cockpit), is provided to extend the landing gear in the event of utility hydraulic pressure failure or if the landing gear handle cannot be positioned to DOWN for any reason. The handle is marked LDG GEAR EXT. When the handle is pulled aft to a stop (approximately 2¼ inches), a valve is manually positioned to shut off landing gear retract pressure and, at the same time, a valve is opened to direct emergency landing gear accumulator pressure to the emergency side of the uplock cylinders, which releases the landing gear uplocks. Both the main and nose gears will extend by gravity and the spring-loaded

downlocks will automatically engage. A slight rocking of the aircraft, after gear extension, may be required to engage the main gear downlocks. In addition to releasing the landing gear uplocks, the landing gear emergency extension handle also actuates a switch that deactivates the anti-spin system solenoid valve.

WARNING

When the landing gear emergency extension handle is pulled aft to extend the landing gear it is possible for the foot to hit it during ejection. Therefore, before ejecting, if circumstances permit, push the handle to the full forward position.

WARNING (Continued)

- Do not reset the landing gear emergency extension handle if the landing gear handle cannot be positioned to DOWN, until ground safety pins are installed. This will prevent possible retraction of the gear and operation of the antispin system.

Note

If the landing gear is extended by the landing gear emergency extension handle in the UP position, wheel brakes will not be available unless the emergency brake handle is pulled.

LANDING GEAR POSITION INDICATORS.

The landing gear position indicator lights (figure 1-60) are green and red legend-type lights providing individual monitoring of each landing gear and are powered by DC primary power. There is a green and red light for the left, right and nose gear. Illumination of a red gear position indicator displays UNSAFE, indicating the particular gear is in an intermediate, down and unlocked, or up and unlocked position. Illumination of a green gear position indicator displays SAFE DOWN indicating the particular gear is down and locked. When all lights are out (and electrical power is available) it indicates all gears are up and locked.

LANDING GEAR WARNING SIGNAL AND LIGHT.

The landing gear warning signal and light circuit flows through the landing gear handle, the landing gear up locks and the landing gear down locks to the three landing gear warning and antispin relays. Any one of the relays can be de-energized under any one of the following conditions:

- When the gear handle is up and any uplock switch is not closed. This could occur during emergency gear extension.
- When the gear handle is down and any downlock switch is not closed.
- When below 10,000 feet at less than 225 KCAS with the throttle more than ½-inch from Military Thrust and any downlock switch is not closed.
- When the L.G. WARNING CONTROL circuit breaker, on the aft end of the right console, is disengaged.

When any one of these conditions exist, the following occurs:

- The red light in the gear handle illuminates.
- One or more of the UNSAFE gear position lights illuminate.
- The warning beeper is heard on the interphone.
- During the up-cycle wheel antispin is applied.
- Wheel antiskid is disabled.



If the landing gear handle light and warning signal (beeper) indicate an unsafe condition, even though all three gear indicators show SAFE DOWN, it should be assumed that the antispin system did not de-energize.

The warning signal and light normally operate together; however, the warning signal may be silenced by depressing the landing gear warning silence button. The light and signal are powered by the DC primary power.

LANDING GEAR WARNING SIGNAL SILENCE BUTTON.

The landing gear warning signal silence button (figure 1-11) is placarded LG WARNING SILENCE. When the button is depressed, the landing gear warning signal (beeper) will be silenced (in the [F] for that cockpit only). If the warning sounds due to any unsafe gear (gear down and any downlock not fully engaged or gear up and not properly locked), and is silenced, it will not sound again until the gear is recycled (or the landing gear warning test button in the [F] front cockpit is momentarily depressed). If the warning sounds due to aircraft configuration (gear not down and locked, altitude below approximately 10,000 feet, airspeed below 225 KCAS and throttle retarded approximately ½-inch below military thrust) and is silenced, it will sound again if the throttle is advanced and again retarded (or if the landing gear warning test button in the [F] front cockpit is momentarily depressed) providing the same conditions exist.

LANDING GEAR WARNING TEST BUTTON.

The landing gear warning test button (figure 1-5) (not in rear cockpit), is placarded LG TEST. When

NOSE GEAR

links

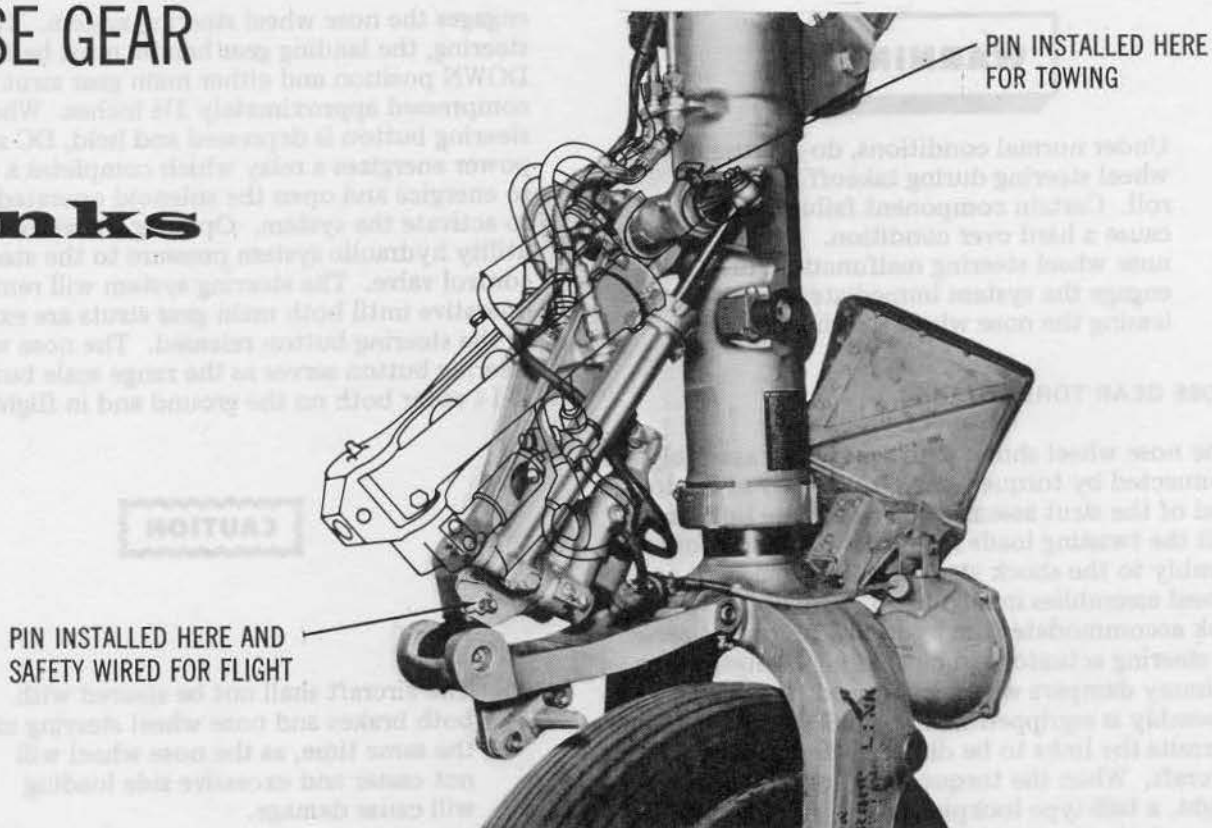


Figure 1-31

depressed and held, the red warning light in the landing gear handle, and the red and green position indicators will illuminate and the warning signal (beeper) will sound on the interphone regardless of the position of the landing gear or throttle. The button is also used to reset the landing gear warning system if the L.G. warning signal has been silenced by the L.G. warning signal silence button.

CAUTION

Depressing the landing gear warning test button is a functional test of the light and beeper only, not of the complete warning system.

NOSE WHEEL STEERING SYSTEM.

The nose wheel steering system is provided for directional control during taxiing, takeoff and landing. On takeoff, the steering may be used up to rudder effective speed (60 KCAS) for all conditions including crosswinds. Although steering can be used up to takeoff speed, it becomes progressively more sensitive above 80 KCAS and on landing the pilot must anticipate this oversensitivity if the

steering is engaged above 80 KCAS. During emergencies, such as blown tires, the aircraft can be held straight at all speeds. The nose wheel steering system is electrically engaged and controlled by DC secondary power and actuated by the utility hydraulic system. Holding the nose wheel steering button depressed energizes and opens the nose wheel steering valve if all the landing gears are extended and either main strut is compressed approximately 1½ inches or more. Movement of the rudder pedals is electrically transmitted to the hydraulic steering control valve which directs hydraulic pressure to the steering unit. The nose wheel steering system is operative within limits of 40 (±5) degrees either side of neutral. To steer the aircraft, the pilot moves the appropriate rudder pedal for the desired turn at which point hydraulic pressure is cut off, and the fluid is confined to aid in shimmy damping. Nose wheel steering is disengaged when both main gear shock struts are extended or the steering button is released, or the landing gear handle is not in the DOWN position.

Note

If the main landing gear shock struts are overinflated, resulting in full extension, the nose wheel steering system will be inoperative.

WARNING

Under normal conditions, do not use nose wheel steering during takeoff or landing roll. Certain component failures can cause a hard over condition. In case of nose wheel steering malfunction, disengage the system immediately by releasing the nose wheel steering button.

NOSE GEAR TORQUE LINKS.

The nose wheel shock strut and wheel assembly are connected by torque links ("scissors") at the lower end of the strut assembly. The torque links transmit the twisting loads from the wheel and fork assembly to the shock strut and keep the strut and wheel assemblies in alignment. The upper torque link accommodates the hydraulic units that serve as steering actuators when steering is engaged, or as shimmy dampers when disengaged. The torque link assembly is equipped with a quick release which permits the links to be disconnected for towing the aircraft. When the torque links are connected for flight, a ball-type lockpin (figure 1-31) is installed through the connection and safety wired, locking them together. The torque links are disconnected by removing the safety wire and the lockpin and lifting the upper torque link. The lockpin is then installed in a hole in the right side of the upper torque link pivot to hold the link up. The torque links are disconnected by removing the safety wire and the lockpin and lifting the upper torque link. The lockpin is then installed in a hole in the right side of the upper torque link pivot to hold the link up. The torque links are connected by removing the lockpin from the upper link pivot, connecting the links and installing the lockpin through the connection and safetying.

CAUTION

Before flight, make sure torque links are connected and lockpin installed properly so that the nose wheel does not swivel freely.

NOSE WHEEL STEERING BUTTON.

The nose wheel steering button (figure 1-27), located on the control stick grip, engages and dis-

engages the nose wheel steering system. To engage steering, the landing gear handle must be in the DOWN position and either main gear strut must be compressed approximately 1½ inches. When the steering button is depressed and held, DC secondary power energizes a relay which completes a circuit to energize and open the solenoid operated valve to activate the system. Opening the valve supplies utility hydraulic system pressure to the steering control valve. The steering system will remain operative until both main gear struts are extended, or the steering button released. The nose wheel steering button serves as the range scale button for R-14 radar both on the ground and in flight.

CAUTION

The aircraft shall not be steered with both brakes and nose wheel steering at the same time, as the nose wheel will not caster and excessive side loading will cause damage.

- Do not engage steering unless aircraft is rolling straight and rudder pedals are approximately in the neutral position. This will avoid abrupt changes in the steering angle when the system is engaged.

WHEEL BRAKE SYSTEM.

Each main wheel is provided with a hydraulically operated multiple disc brake and a power brake valve. When the landing gear handle is in the DOWN position, utility hydraulic system pressure is applied to the inlet port of the power brake valves. When the rudder pedals are depressed, the power brake valves supply metered pressure to the multiple disc brakes. The metered pressure is proportional to brake pedal deflection. An antispin system prevents rotation of the wheels when the landing gear is being retracted. When the landing gear handle is placed in the UP position, reduced utility hydraulic system pressure is applied to the brakes to stop wheel rotation. When the uplocks engage, hydraulic pressure is shut off and the brake deenergized. If the hydraulic system fails, emergency brake pressure is supplied to the normal brake system by an accumulator and is manually selected.

WHEEL BRAKE OPERATION.

Full power operated wheel brakes are installed. The feel and controllability of the brakes is good and all necessary ground maneuvering except the tightest ramp maneuvers can be accomplished, if necessary, without nose wheel steering. If the antiskid system

is inoperative, the following remarks are applicable. At the higher speeds of landing rolls (above 120 KCAS) the wheels can be locked quite easily, but at lower speeds on dry runways heavy braking can be used. However, a dynamic condition of gear walking may be experienced occasionally following brake application, particularly at speeds of 40 to 50 knots and below. Should this reach severe proportions,

the walking can be stopped by release of brakes followed by reapplication.

To minimize brake wear, the following precautions shall be observed insofar as is practicable:

1. Use extreme care when applying brakes immediately after touchdown, or at any time there is considerable lift on the wings, to prevent skidding the tires. Heavy brake pressure will lock the wheels more easily immediately after touchdown than when the same pressure is applied after the full weight of the aircraft is on the tires. A wheel once locked in this manner immediately after touchdown will not become unlocked as load increases, as long as brake pressure is maintained. Brakes can stop the wheels from turning, but stopping the aircraft is dependent on the frictional force between the tires and the runway. There are two reasons for the loss of braking effectiveness with skidding. First, the immediate action is to scuff the rubber, tearing off little pieces which act almost like rollers under the tire. Second, the heat generated starts to melt the rubber and the molten rubber acts as a lubricant. If one wheel is locked during application of the brakes, there is a tendency for the aircraft to turn away from that wheel, and further application of brake pressure offers no corrective action. Since friction decreases when the wheel begins to skid, it is apparent that a wheel, once locked will never free itself until brake pressure is less than the turning moment. Brakes equipped with an antiskid system may be applied immediately after touchdown, but this should be done only when definitely necessary. The antiskid system functions to prevent tire skidding if it is operating properly; however, it is not designed to perform as a completely automatic braking system.
2. When a short landing roll is required, a single, smooth application of the brakes with constantly increasing pedal pressure will result in optimum braking. This procedure is applicable at all times when operating on normal or emergency brake systems.
3. The brakes should not be dragged while taxiing, and should be used as little as possible for turning the aircraft on the ground.
4. At the first indication of brake malfunction, or if brakes are suspected to be in an overheated condition after excessive use, the

aircraft should be maneuvered off the active runway and stopped. The aircraft should not be towed into a crowded parking area. Overheated wheels and brakes will be cooled before the aircraft is subsequently towed or taxied. Peak temperatures in the wheel and brake assembly are not attained until some time after a maximum braking operation is completed (the time required may vary from 15 to 60 minutes). In extreme cases, heat buildup can cause the wheel and tire to fail with explosive force or be destroyed by fire if proper cooling is not effected. Taxiing at low speeds to obtain air cooling of overheated brakes will not reduce temperatures adequately and can cause additional heat buildup. Pilots should caution ground personnel to stay clear of hot brakes. Refer to Brake Limitation in section V for cooling requirements between successive landings.

EMERGENCY BRAKE HANDLE.

The emergency brake handle (17, figure 1-3) is a manual control marked EMERG BRAKE. On [E] aircraft both handles are mechanically interconnected, and when the handle in one cockpit is pulled, the handle in the other cockpit will move aft also. When the handle is pulled aft to its stop (approximately 2 inches), a selector valve is mechanically positioned to transfer the brake system hydraulic pressure supply from the down side of the landing gear system to the emergency brake accumulator. Brakes are then applied in the normal manner by depressing the rudder pedals. With the accumulator fully charged, enough pressure is available for three full brake applications. The antiskid brake system is inoperative when the emergency brake handle is pulled aft.

ANTISKID BRAKE SYSTEM.

An electrically controlled hydraulically operated antiskid system is installed in the wheel brake system to prevent blown tires and uneven tire wear due to prolonged locked wheel skids. The antiskid system is not designed or intended to be used as an automatic braking system. The complete antiskid system consists of two sensing units, two on-off control valves, a transistorized control box and a hydraulic modulating subsystem. The two sensing units, one on each of the main wheels, are friction driven DC generators. While the aircraft is moving along the ground, each generator supplies a DC voltage to the control box proportional to the wheel rotation speed. The control box which has a separate circuit for each main landing gear system,

will sense the rate of change of the voltage so that when the appropriate wheel is decelerating excessively in entering a skid, the control box will energize the solenoid on-off control valve to dump the brake pressure of that wheel. With the brake pressure removed, the skid will be arrested and the wheel will start to regain rotation speed. When the wheel has completely recovered its rotating speed the brake pressure will be reapplied automatically. The hydraulic pressure modulation system causes the brake pressure to be reapplied gradually until it reaches the pressure level called for by the pilot. This feature is incorporated to eliminate excessive pitching of the aircraft and to prevent rapid repetition of wheel skids. A fail safe feature is provided which will deenergize the antiskid system and restore manual braking if a malfunction causes a continuous dump signal in excess of 3 seconds. When the fail safe feature has de-energized the system, it must be reset by the ground crew. With the aircraft on the ground you can determine if the fail safe system is energized by holding slight brake pressure and turning the antiskid switch ON. A slight pedal pulse or kick will indicate that the antiskid system is energized. If a pedal pulse is not detected during the antiskid check, the crew chief should feel the brake line on the main gear while the check is repeated. If the pulse is not felt, assume that the antiskid circuit is inoperative. Specific characteristics of the antiskid system are as follows:

- The antiskid operation for each main wheel is separate. The pressure is dumped only on the wheel which enters a skid.
- When only one wheel is skidding or the two wheels skid out of phase, some transient aircraft yawing is to be expected (and corrective steering by the pilot is required).
- The antiskid system will not anticipate wheel skids but will sense the deceleration when the wheel is entering a skid. At aircraft speeds below 60 knots, wheel-lock may occur but will not exceed one quarter of a second duration. This is due to the unavoidable electric and hydraulic time delays in releasing the brake pressure.
- The modulating system prevents the tendency toward immediate skid re-entry following each skid recovery. However, if the pilot continues to hold the pedal at a position where the brake pressure is above the skidding level, repeated skids may still occur. The modulating system

will effectively slow down the frequency of skid recurrency, thus avoiding resonance with aircraft pitching.

CAUTION

On aircraft with an inoperative antiskid system maximum braking at speeds below 60 knots may cause wheel skidding which can result in gear walking and excessive strut loads. If this condition occurs braking effort should be reduced slightly.

During a normal landing, the operating procedure for the antiskid brake system should not differ from operation without antiskid. Energizing the antiskid prior to all landings is recommended to provide protection from inadvertent locked wheel skids. If maximum braking is required, the exact amount of brake pressure which can be applied without risking a locked wheel skid is difficult to determine. This is because the friction force available at the wheel depends on many variables such as aircraft weight, wing lift, runway conditions, etc. To obtain optimum braking with antiskid, the pilot should be familiar with the following practices applicable to the antiskid system.

1. Repeated antiskid cycling indicates excessive brake pressure and the brake pressure should be reduced. The best braking performance will be produced when the brake pressure level is maintained just short of that causing antiskid.
2. When asymmetric skids occur, the unequal ground reactions on the two wheels will produce a short duration yawing moment on the aircraft. This may result in a change of heading which is more noticeable at low aircraft speeds. The pilot should expect to take appropriate corrective action in steering the aircraft.
3. Antiskid cycling will easily be detected by the pilot since a brake release and the subsequent reduction in ground drag will cause the main landing gear to roll sharply forward. This condition is normal and is definitely more noticeable below 60 knots.
4. For approximately 1 second after a wheel skid, the maximum brake pressure available is limited by the action of the modulating system. Increased pedal deflection during the period will not result in immediately increased brake

pressure. If differential braking is necessary immediately after skid recovery, the pilot should back off on the side where lower pressure is desired.

5. Antiskid will not be available if the antiskid switch is off, if the emergency brake handle has been pulled or if the landing gear handle warning light is on. If antiskid is not available, the wheels can be locked quite easily at speeds above 120 KCAS, but heavy braking can be used at lower speeds on dry runways. A dynamic condition of gear walking may be encountered at speeds below 60 knots and if it reaches severe proportions, the walking can be stopped by release of the brakes followed by reapplication.

Antiskid Switch.

The antiskid switch (figure 1-5) (not in rear cockpit), is a two-position switch with positions placarded ANTISKID and OFF. The ANTISKID position makes DC primary power available to operate the system when the emergency brake handle is in the full-forward position, the weight of the aircraft is on the main gear struts, either main wheel is rotating at a speed above 10 MPH, and the light in the landing gear handle is not illuminated. The OFF position deactivates the system.

ARRESTING HOOK.

The arresting hook installed on the aft fuselage centerline in the ventral fin is provided for runway overrun engagement with the BAK-6 water squeezer, BAK-9 brake system, BAK-12 tape system or the hook modified MA-1A chain barrier. The self-centering hook assembly is attached to the aircraft structure by a pivot on its forward end and fitted with a spade hook on its aft end. The hook is held in the UP position by a shear pin. For extension the pin is sheared by an electrically ignited explosive charge. When the pin is sheared, a cylinder combining the features of an accumulator and a shock strut, extends the hook and holds it in contact with the runway. The cylinder prevents the hook from bouncing and absorbs some energy upon cable engagement. A pressure gage is provided to indicate cylinder precharge and is visible through a hole in the hook support beam. An external ground lock is provided. The lock, with a red warning streamer, is installed to prevent injury to personnel from inadvertent extension. The lock must be removed before flight.

ARRESTING HOOK SWITCH.

The arresting hook switch (figure 1-5), placarded ARREST HOOK, is a two-position toggle switch with positions UP and DOWN. The switch is spring-loaded to the UP position and protected by a cover-type guard. Momentarily holding the switch to the DOWN position completes a circuit from the battery bus to ignite the explosive charge which shears the pin that holds the hook up. When the pin is sheared, a cylinder extends the hook and holds it in contact with the runway. Once extended, the hook cannot be retracted in flight.

ARRESTING HOOK DOWN INDICATOR LIGHT [F]

The arresting hook-down indicator light (figure 1-60) on the caution light panel, displays ARREST HOOK DOWN when illuminated and is powered by DC primary power. The lights illuminate when the arresting hook is in the down position.



In the event of a tail scrape, the supporting structure of the arresting hook down switch may be damaged resulting in illumination of the arresting hook down light although the hook is in a stowed (UP) or near stowed position. If a tail scrape has been encountered and a barrier engagement is contemplated, the arresting hook switch should be placed DOWN regardless of the caution light. If a go-around is accomplished after a tail scrape a tower check for hook position should be made prior to landing.

DRAG CHUTE SYSTEM.

The 20-foot drag chute, used to reduce landing ground roll distance after touchdown for all landings, is packed in a deployment bag and stowed in an air cooled compartment in the aft fuselage at the base of the rudder. A riser (nylon cable) connects the drag chute to the jettison hook on the aircraft. The compartment is equipped with a door, spring-loaded to the open position, and a manually actuated latch lock and unlock mechanism controlled by an L-shaped handle in the cockpit. The drag chute release mechanism has a safe arming device that automatically releases the chute from the aircraft if it is deployed by any action other than movement of the drag chute

handle. Normally in the door closed position, the riser yoke is held in the jettison hook by spring tension. Positive hook engagement is accomplished when the drag chute handle is pulled, opening the door and deploying the chute. Drag chute deployment speed is restricted to protect the drag chute from damage. A pin with a red streamer (figure 1-24) is used to disarm the pilot chute ejection spring to retain the pilot chute when the door is opened for inspection.



The drag chute disarming pin must be removed before flight.

DRAG CHUTE HANDLE.

The drag chute handle (figure 1-5) (not in rear cockpit), is an L-shaped handle marked DRAG CHUTE. To deploy the drag chute the handle is pulled aft, approximately 2½ inches. This motion is transmitted by cables to a bellcrank arrangement which locks the jettison hook, holding the riser shackle to the aircraft, and unlatches the spring-loaded door. As the drag chute door is opened, the pilot chute spring is released and ejects the pilot chute into the airstream. Wind action on the pilot chute pulls the drag chute free of the deployment bag and clear of the aircraft. The handle will lock in the deployed position. To jettison the drag chute the parachute shaped button in the handle is depressed to release a lock, the handle is then rotated 90 degrees counterclockwise and pulled aft an additional 3 inches.



To prevent inadvertent jettisoning of the drag chute, the handle should not be rotated until jettisoning is required.

AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS).

The automatic flight control system (AFCS) provides the aircraft with three basic modes of operation:

- Stability Augmentation (stab-aug).

- Pilot Relief (AUTOPILOT) with submodes of Altitude-hold or Mach-hold and NAV or TRACK hold.
- Fully automatic modes of ILS (automatic Instrument Landing System) and AUTOSS (automatic-Toss-Bomb) maneuver.

All AFCS controls are located on a single control panel (figure 1-32) on the left console. An AFCS emergency disconnect lever on the control stick permits disengagement of all AFCS modes. In the **F** FLIGHT control transfer (take-over) button in each cockpit (figure 1-62) permits either the front or rear crew member to take control of the AFCS. The system is powered by AC and DC secondary power and the primary one hydraulic system. Refer to figure 1-33 for the signal flow diagram of the AFCS.

FLIGHT CONTROL TRANSFER (TAKE-OVER) BUTTONS. **F**

The flight control transfer (take-over) button in each cockpit (figure 1-62) is a solenoid-held push-button switch placarded FLIGHT, and permits transfer of AFCS control between cockpits. To take over control of the AFCS from the other cockpit, depress the FLIGHT take-over button (the button should remain engaged and the NO CONTROL light should go out). Control is transferred as long as the NO CONTROL light goes out whether the button remains engaged or not. When flying solo, or when system transfer has not taken place since application of electrical power, the front cockpit has control of the AFCS even through the FLIGHT take-over button is not engaged. Illumination of the NO CONTROL light in the button is the only true indication of who does not have control of the system. Whenever the FLIGHT take-over button is depressed, all functions of the AFCS are disengaged except stab-aug and they must be reengaged by the cockpit taking over. The take-over system is powered by DC primary power and the indicator lights are powered by AC primary power.

Note

- F** The AFCS functions may be engaged in either cockpit by engaging the FLIGHT take-over button. The take-over button for an AFCS tie-in system (Compass, Doppler, ILS, Fire-Control) does not have to be engaged in the same cockpit as the FLIGHT take-over button.

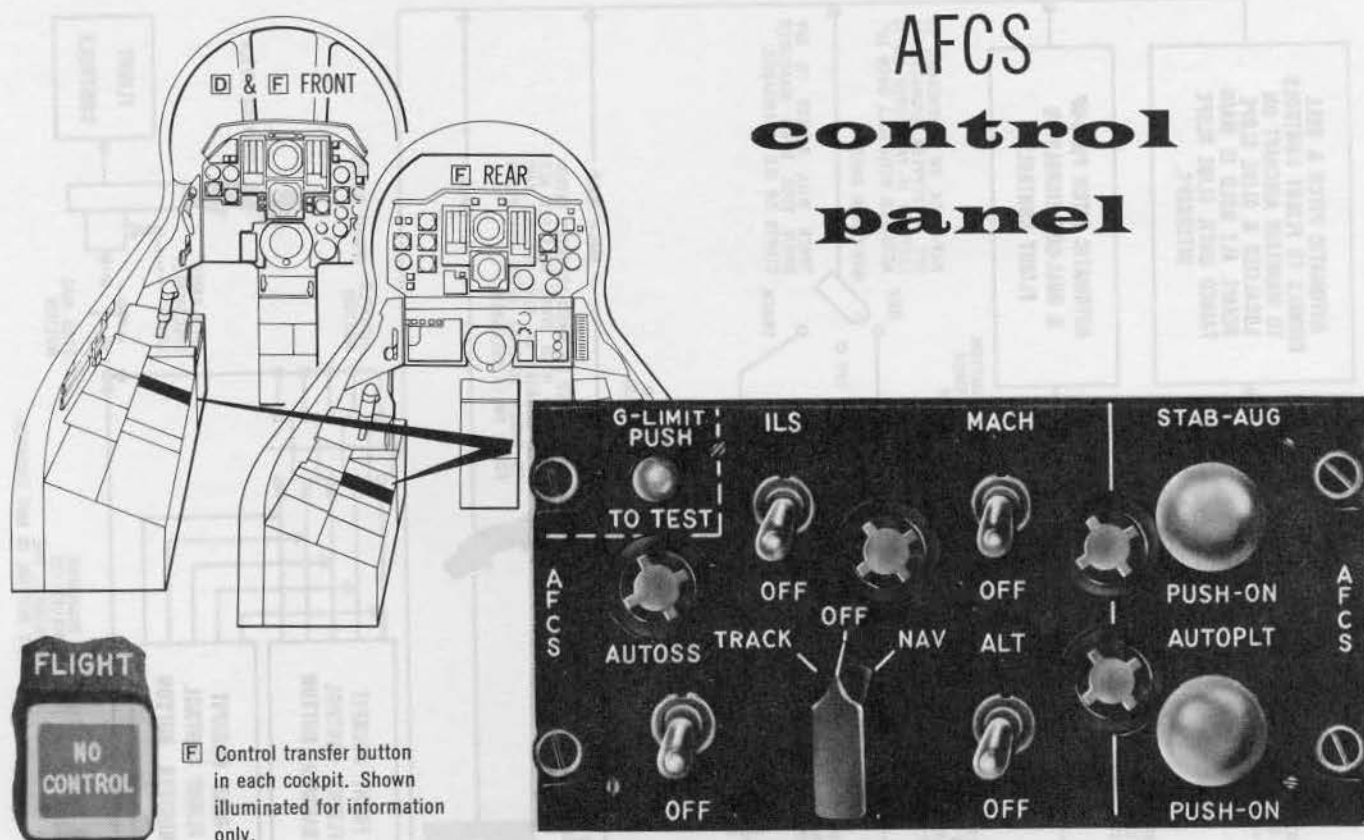


Figure 1-32

STAB-AUG (STABILITY AUGMENTATION) MODE.

The stab-aug mode of operation improves control of the aircraft by damping oscillations about its pitch and yaw axes. Automatic turn coordination is provided to counteract sideslip or skid. There is no evidence of stab-aug action at the control stick or rudder pedals, except for the increased stability of the aircraft. Rate gyros detect oscillations and generate signals which result in control surface deflection to counteract (or dampen) any oscillations of the aircraft. In addition, if lateral acceleration exists during maneuvers, a portion of the roll rate gyro signal is amplified by the sideslip control amplifier and in turn excites the lateral accelerometer. The lateral accelerometer generates a signal proportional to the lateral acceleration force on the aircraft. The combined roll rate error and lateral accelerometer error signals result in rudder deflection to counteract sideslip, or skid of the aircraft. The pitch and yaw servocylinders are connected in series with the manual control system and provide control response without corresponding movement of the stick or rudder pedals. The servocylinders, in response to electrical signals from the rate gyros and lateral accelerometer, position the control

valves of the flight control tandem actuators. When stab-aug is inoperative (disengaged or interrupted) the series servocylinders lock in their center position and act as fixed links in the flight control system. Stab-aug incorporates provisions for manual disengagement, automatic disengagement and interruption as follows:

Manual disengagement by:

- Pilot actuation of the AFCS emergency disconnect lever. (In the **F**, actuation of either emergency disconnect lever, disengages the AFCS.)
- Pilot pulling the stab-aug button UP in the **D**. In the **F** both stab-aug buttons must be UP.

Automatic disengagement by:

- The malfunction detector circuit.
- Loss of AC or DC power.
- AC frequency below normal.
- Loss of primary one hydraulic pressure.

AFCS SIGNAL FLOW DIAGRAM

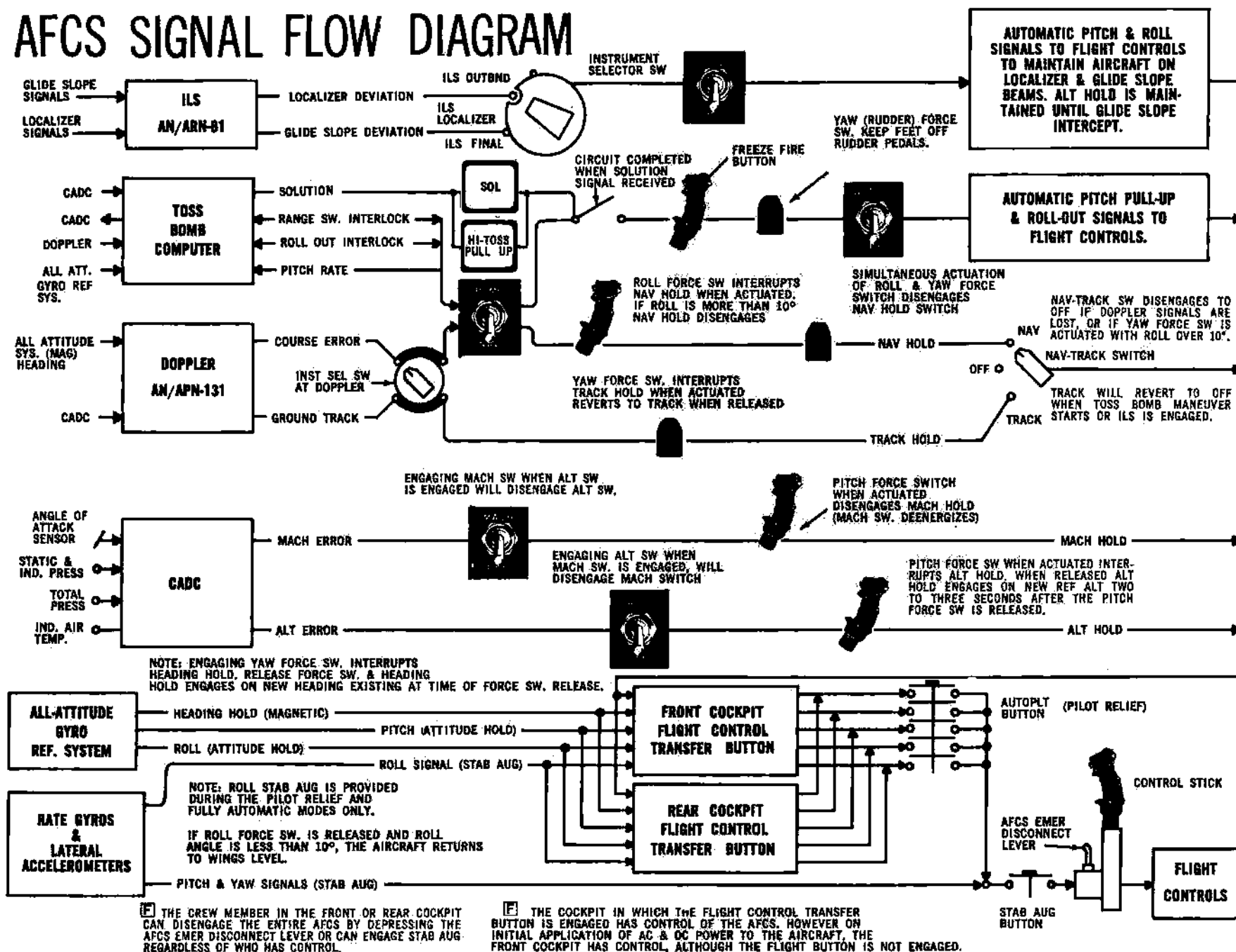


Figure 1-33

Automatic interruption by:

- AC frequency momentarily below normal.
- Primary one hydraulic pressure below normal.

When stab-aug is disengaged, the stab-aug button will pop up and the STAB-AUG OFF caution light will illuminate. When stab-aug is interrupted, the stab-aug button will *remain depressed* and the STAB-AUG OFF caution light will illuminate. If the condition causing an interruption is corrected, stab-aug will automatically become operative again. *Stab-aug operation is necessary for all other modes of AFCS operation.*

WARNING

When flying at extremely low altitudes, when possible, one hand should remain near or on the emergency disconnect lever.

Stab-Aug Button.

The stab-aug button (figure 1-32) is a solenoid-held push-pull switch placarded STAB-AUG, PUSH-ON, and is used to engage and disengage stab-aug. Depressing the button energizes and opens the normally closed shutoff valves, porting primary one hydraulic pressure to the series servocylinders, unlocking them and permitting them to move in response to signals from the rate gyros and accelerometers. The stab-aug button cannot be engaged unless DC secondary power is available and AC secondary power has been available for approximately 30 seconds. Manually pulling the button up will disengage stab-aug. The button will pop up and automatically disengage stab-aug under the conditions stated in the preceding paragraph. *The button must be depressed and remain engaged for all modes of AFCS operation.* In the [F], stab-aug can be engaged by either crew member regardless of which cockpit has the FLIGHT take-over button engaged.

AFCS Emergency Disconnect Lever.

The AFCS emergency disconnect lever (figure 1-27) on the forward side of the control stick is provided for immediate disengagement of all modes of AFCS operation. Depressing the lever disconnects electrical power from the AFCS circuitry.

WARNING

Whenever any unusual oscillations or vibrations are felt in the controls, immediately depress the AFCS emergency disconnect lever in order to isolate the trouble to flight controls of AFCS.

- If stab-aug is manually disengaged, or automatically disengaged (button pops up) due to AFCS malfunction during flight, it shall not be reengaged, until:
- Flight controls are trimmed.
- Aircraft attitude is stabilized.
- Altitude is sufficient for a recovery if a malfunction occurs.

Note

The AFCS emergency disconnect lever should be used as the normal means of disengagement for the fully automatic modes (ILS and AUTOSS).

Stab-Aug Off Caution Light.

The stab-aug off caution light (figure 1-60) on the caution light panel displays STAB-AUG OFF when illuminated, and is powered by DC primary power through the MECH ADV SHIFT circuit breaker (figure 1-21). Illumination of the caution light indicates that stab-aug is disengaged, interrupted, or the system is in standby (when power is initially supplied to the aircraft and before stab-aug has been engaged). When the circuit to the pitch and yaw solenoid shutoff valve is energized for stab-aug operation, the normally closed caution light relay is energized and opened, and the caution light is extinguished. When the circuit is de-energized, the relay closes and the caution light illuminates.

G-Limit-Button (Ground Test Only).

The G-limit button (figure 1-32) placarded G-LIMIT, PUSH TO TEST, is a pushbutton switch *used for ground check only* of the pitch monitor (or malfunction detector) circuit. The pitch monitor circuit automatically disengages the AFCS if a malfunction drives the pitch series actuator 90 percent hard over in the opposite direction to that being

commanded by the pitch rate gyro. Depressing the button on the ground actuates the pitch series actuator hard over and simulates a malfunction by driving the stabilizer leading edge up without a signal from the pitch rate gyro.

Stab-Aug Operation.

Stab-aug is engaged prior to takeoff or anytime during flight (regardless of which cockpit has control of the AFCS in the [E]), provided that aircraft controls are trimmed, aircraft attitude is stabilized, and altitude is such that a recovery could be made if a malfunction occurs.

WARNING

If stab-aug disengages automatically, during flight, do not reengage until:

- Flight controls are trimmed.
- Aircraft attitude is stabilized.
- Altitude is sufficient for a recovery if a malfunction occurs.

PILOT RELIEF (AUTOPILOT) MODE.

The pilot relief mode of operation provides the aircraft with various holding functions which relieve the pilot from maintaining constant manual control of the aircraft. These functions are attitude-heading-hold, automatic trim correction, altitude- or Mach-hold and track- or NAV-hold. Force switches, incorporated in the rudder pedals and the base of the stick grip, detect pilot-applied forces on the controls and permit him to override the pilot relief mode at any time.

Autopilot Button.

The autopilot button (figure 1-32) is a solenoid-held, push-pull switch placarded AUTO-PLT, PUSH-ON and is used to engage and disengage the pilot relief mode of the AFCS. The button may be engaged, and will remain engaged provided the FLIGHT take-over button in the [F] is engaged, AC and DC secondary power have been available for approximately 1 minute, and stab-aug is engaged (stab-aug button IN). When the autopilot button is depressed (pilot relief mode engaged), roll stability augmentation becomes operative

and the aircraft will maintain the attitude and heading existing at the time of engagement provided the force switches are not actuated (no pilot force on controls) according to the following schedule of operation and limitations:

Conditions at time of AUTOPLT Engagement	Roll Attitude Hold	Return to Wings Level	Heading Hold	Pitch Attitude Hold
Roll under 10 ± 3 degrees Pitch under 66 ± 6 degrees	No	Yes	Yes	Yes
Roll between 10 ± 3 & 45 ± 5 degrees Pitch under 66 ± 6 degrees	Yes	No	No	Yes
Roll between 45 ± 5 & 66 ± 6 degrees Pitch under 45 ± 5 degrees	Yes	No	No	No
Roll over 45 ± 5 degrees Pitch over 45 ± 5 degrees	No	No	No	No
Roll anywhere Pitch over 66 ± 6 degrees	No	No	No	No
Roll over 66 ± 6 degrees Pitch anywhere	No	No	No	No

As noted above, if the roll attitude is less than 10 ± 3 degrees, the aircraft will return to wings level and assume automatic heading. However, activation of a yaw force switch while in this attitude will cease operation of heading-hold and commence operation of roll-attitude-hold. With this technique it is possible to hold bank angles of under 10 degrees.

If the above conditions are not established when the autopilot button is depressed, attitude and heading-hold will not engage until they are established. Signals for attitude and heading-hold are provided by the all-attitude gyro reference system. Automatic trim correction is provided by the pitch and roll trim actuators repositioning the controls (and control stick) at a slow rate. The trim correction occurs only when the force switches are not actuated. If the AFCS calls for pitch maneuvers which result in greater than 2.25G or less than 0G, the automatic trim will not function. (Manual trim at the normal rate is available when either force switch is activated.) Pulling the autopilot button up disengages the pilot relief mode (and submodes) and fully automatic modes of the AFCS.

Note

- [F] The autopilot button will disengage anytime the NAV take-over button is engaged

Note (Continued)

If the compass function selector knob, in the cockpit taking over, is at SLAVED. If the function selector knob is in DG the autopilot button will not disengage.

Autopilot (Pilot Relief) Operation.

The autopilot button should only be depressed after the aircraft is airborne and in the **[F]**, when flying dual the FLIGHT take-over button in the cockpit assuming control is engaged. Engagement of the autopilot button provides heading and attitude control if the aircraft is within engagement limits. If the vertical gyro fast-erection button is depressed, the Pilot Relief functions will be interrupted and will again be operative when the erection button is released. Mach-hold, however, will disengage and must be manually reengaged. However all reference inputs will be synchronized and the same condition will exist as if the system were interrupted by actuation of pitch or roll force switches. If the PUSH TO SYNC button on the compass control panel is depressed, the compass is slewed, or the function selector knob is moved from DG to SLAVED, the AUTO PLT button will disengage.

When the autopilot button is engaged in straight and level flight (less than 10 degrees of roll), there should be no objectionable transient. Tolerable transients should not be greater than 0.25G or 10 degrees per second roll rate. The aircraft should stabilize and maintain heading, pitch attitude, and approximate wings level. The AFCS uses roll control to maintain heading. Dependent upon aircraft trim or symmetry, bank angles of up to 5 or 6 degrees may be required to hold heading. The criterion is that heading is maintained. The maximum bank angle which can be commanded by heading error signals is 14 ± 4 degrees and the maximum bank angle which can be commanded by track error signals is 10 ± 3 degrees, to prevent erratic maneuvers as a result of any malfunction in the systems which supply heading and track signals.

CAUTION

If any unusual roll oscillations or roll wobbles exist on pilot relief modes, the pilot should activate the rudder force switches. If this corrects the problems, it can be assumed that the compass system was feeding an erroneous heading error signal to the AFCS. If the condition is not corrected, immediately

depress the AFCS emergency disconnect lever to disengage the AFCS.

Altitude Switch.

The altitude switch on the AFCS control panel (figure 1-32) is a two-position toggle switch with a solenoid-held ALT position, and is spring-loaded to the OFF position. The switch is used to engage and disengage the altitude-hold submode of the pilot relief mode of the AFCS. With the stab-aug and autopilot buttons engaged the FLIGHT control transfer (take-over) button engaged in the **[F]**, the altitude switch may be engaged (positioned to ALT) and will remain engaged. (Engaging the altitude switch will disengage the MACH switch automatically if engaged.) Altitude error signals for maintaining the reference altitude are provided by the CADCS.

Altitude Hold-Operation.

To obtain altitude hold, the altitude switch (in the cockpit which has AFCS command in the **[F]**) should be engaged when the desired altitude is reached. When altitude-hold is engaged, the aircraft will maintain this altitude existing at the time of engagement (reference altitude) within ± 30 feet or ± 0.2 percent, whichever is greater. For rates of climb or dives of less than 1000 feet per minute, the engaging transients and overshoots are mild. For steep climbs or dives, the initial transient can be quite sharp. With altitude-hold engaged, the pilot may change the reference altitude by climbing or diving to a new reference altitude. When a force switch is actuated during a change in altitude the altitude-hold function is interrupted until the force switch is released at which time the AFCS will maintain the aircraft altitude existing at the time of force switch release. However, the aircraft will not lock-on to the new reference altitude for at least 2 seconds after release of the force switch.

Altitude-hold should give acceptable performance up to Mach 0.95 as indicated on the AVVI and AMI. If the aircraft is accelerated through the transonic region (Mach 0.95 to 1.1) several sharp pitch oscillations will occur but the system will not disengage. The altitude-hold switch may be disengaged with no pitch transient.

CAUTION

Do not accelerate through the transonic region below 5000 foot ground clearance with altitude-hold engaged.

Mach Switch.

The Mach switch on the AFCS control panel (figure 1-32) is a two-position toggle switch with a solenoid-held MACH position and is spring-loaded to the OFF position. The switch is used to engage and disengage the Mach-hold submode of the pilot relief mode of the AFCS. With the stab-aug and autopilot buttons engaged (the FLIGHT control transfer button engaged in the ☐) and the ILS switch OFF, the Mach switch may be engaged (positioned to MACH) and will remain engaged. (Engaging the Mach switch will disengage the altitude switch automatically if engaged.) When Mach-hold is engaged, the aircraft will maintain the Mach number existing at the time of engagement within ± 0.03 Mach in steady flight conditions. Changes in power settings may cause deviations in Mach not to exceed ± 0.05 Mach. Mach error signals for maintaining the selected Mach number are provided by the CADC. If the pitch force switches are actuated, the Mach switch will automatically disengage and the aircraft will revert to attitude-hold upon stick release. The Mach switch may be reengaged after a two-second delay if desired to reengage the Mach-hold function.

Note

If the vertical gyro fast-erect button is depressed, the Mach switch will move to OFF.

Mach Hold Operation.

To obtain Mach-hold, the Mach switch (in the ☐ , the FLIGHT control transfer button must be engaged) should be engaged when the desired Mach number is reached. Mach-hold should give acceptable performance up to Mach 0.95 as indicated on the AMI. If Mach-hold is engaged in the transonic area between Mach 0.95 and Mach 1.1, transients will exist but the system should stabilize. If the pilot switches from Mach-hold to Altitude-hold without being in a steady state flight condition, a large transient can result. If the aircraft is in a steady state flight condition for approximately 25 seconds, any attitude transient should be within plus or minus 2 degrees. If the aircraft is carefully stabilized and trimmed before engaging Mach-hold, and the climb angle is shallow, climbs with afterburner should be stable. If these conditions are not met, pitch oscillations may result during afterburner Mach-hold performance. To avoid a pitch transient, the Mach-hold mode should be disengaged by use of the control stick pitch force switches.

Track/Nav Switch.

The track/nav switch on the AFCS control panel (figure 1-32) is a three-position rotary switch spring-loaded to a neutral OFF position with solenoid-held positions placarded TRACK and NAV.

The switch can be positioned to, and will remain engaged in, the TRACK or NAV position provided:

- ☐ • FLIGHT control transfer (take-over) button is engaged.
- The stab-aug button is engaged.
- The autopilot button is engaged.
- The ILS switch is OFF.
- The Doppler heading reference switch has been in DG or MAG for approximately 3 minutes and Doppler signals are available.
- The aircraft bank angle is less than 10 ± 3 degrees (not required to engage TRACK-hold).
- Feet are off rudder pedals (yaw force switches not actuated). (The above condition is not required to engage TRACK-hold.)
- The BOMB/NAV switch is in NAV (not applicable for TRACK operation).

When the TRACK position is selected (engaged), ground track signals from the Doppler will maintain the aircraft on the ground track existing at the time of engagement. (If either the ALT or MACH switch is engaged, the aircraft will also hold the altitude or Mach existing at the time of engagement.) When the NAV position is selected (engaged), signals from the Doppler will maintain the aircraft on the great circle course to the destination coordinates preset into the Doppler. If a roll force is applied and the bank angle exceeds approximately 10 degrees, or roll and yaw force switches are actuated simultaneously, or the BOMB/NAV switch is at BOMB when the radar system is at STDBY or ON (except search and attack), the NAV position of the TRACK/NAV switch will disengage. Track-hold will disengage upon initiation of an AUTOSS or automatic wings level maneuver. Track and/or NAV-hold will disengage upon the engagement of ILS.

Navigation/Track Hold Operation.

To obtain track-hold, the TRACK/NAV switch is positioned to TRACK (in the **[F]** cockpit which has AFCS control) while the aircraft is flying the desired track and will maintain the ground track existing at the time of engagement within plus or minus 2 degrees. The track may be changed by applying a roll force to the control stick. This will interrupt track-hold, but it will reengage automatically on the new track that exists when the force is removed from the roll force switches. With the radar system operating in ground map, and the Doppler operating, the azimuth cursor on the radar indicator displays the ground track of the aircraft. To obtain NAV-hold, the TRACK/NAV switch is positioned to NAV after both the present position and destination coordinates have been set into the Doppler. The hold limits should be within 4 degrees of the reference indicated by the heading marker on the HSI. In acquiring the great circle course, the aircraft bank angle is limited to 30 ± 9 degrees. The bank steering bar may not be centered during acquisition phase. If a roll force is applied to the control stick resulting in a bank angle of less than approximately 10 degrees, the NAV-hold function will be interrupted, but will reengage automatically on the course necessary for the same destination upon release of the roll force switches. If the bank angle exceeds approximately 10 degrees, the NAV-hold will disengage. At no less than 50 miles from destination, the TRACK/NAV switch should be turned from NAV to TRACK and the correct track established. This is indicated when the command heading marker is aligned with the vertical lubber line on the HSI, i.e., when the course steering error is zero. Within this short range, Doppler course angle navigation solutions may not afford good AFCS performance on NAV-hold and will result in objectional transients and roll corrections.

FULLY AUTOMATIC MODES.

The fully automatic modes of the AFCS enable the aircraft to make an automatic instrument approach to a runway, an automatic toss bomb maneuver, and to maintain automatic wings level on a bombing run. In these modes, the control stick moves in conjunction with the flight control surfaces. Electro-mechanical rotary actuators are connected in parallel with the control linkage to the control valves of the flight control tandem actuators. The rotary actuators position the control valves in response to signals from the ILS radio, All-attitude system, and central-air-data computer system. The ability to

initiate an AUTOSS or Automatic wings level maneuver is governed by a fire control interlock. However, the AUTOSS maneuver is programmed by the AFCS using references from the All-attitude-gyro-system and the AFCS pitch rate gyro. The automatic wings level maneuver is controlled by the AFCS using reference from the All-attitude-gyro-system, automatic pitch trim is provided, but is interrupted any time a pitch force is applied to the control stick, or a maneuver results in normal acceleration greater than 2.25G or less than 0G.

ILS Switch.

The ILS switch on the AFCS control panel (figure 1-32) is a two-position toggle switch with a solenoid-held ILS position and is spring-loaded to the OFF position. The switch is used to engage and disengage the automatic instrument landing system. The ILS mode uses ground-originated localizer and glide slope signals to the AFCS, to actuate control surfaces for an automatic instrument approach to a runway. The switch can be positioned to, and will remain engaged in the ILS position, provided:

- [F]** • FLIGHT control transfer (take-over) buttons are engaged in the cockpit taking control of the aircraft.
- The stab-aug button is engaged.
- The autopilot button is engaged.
- The ILS (AN/ARN-61) function switch is ON.
- The instrument selector switch is at ILS-LCL, or FINAL.
- The autoss maneuver has not been initiated.
- The pitch force switches are not actuated.

When the ILS switch is engaged, the AFCS controls the aircraft roll attitude as required for localizer beam acquisition and retention. At initial ILS bracketing, the maximum bank angle corrective is limited to 30 ± 9 degrees, decreasing to 10 ± 3 degrees approximately 150 seconds after glide slope engagement. Altitude-hold is automatically provided until the point of glide slope intercepts. The auto ILS system will not accept glide slope information for approximately 17 seconds after the ILS switch is engaged. At glide slope interception altitude-hold is automatically disconnected and the pitch attitude is controlled by the ILS glide slope signals as required to maintain the aircraft on the

glide slope. During this phase of the approach, if the instrument selector switch is in the ILS-LCL position the pitch steering bar on the ADI will be inoperative. When the instrument selector switch is positioned to ILS-FINAL, the pitch steering bar will become operative. The flare-out and landing must be made manually.

Note

Although the ILS switch or autopilot button will disengage ILS and all pilot relief functions, the AFCS emergency disconnect lever should be used to disengage all AFCS functions.

Automatic ILS Approach Operation.

To prepare for an automatic ILS approach to a landing runway, the AN/ARN-61 receiver must be ON and tuned to the appropriate station frequency; the STAB AUG and AUTO PLT buttons must be engaged (and in the [E] the FLIGHT control transfer (takeover) button must also be depressed and remain engaged in the cockpit with control prior to engaging the AUTO PLT button).

WARNING

Do not engage the ILS switch on the AFCS control panel if there is a suspected malfunction of the flight director computer, or the course warning flag is visible. Also, if after engagement of the ILS switch and the glide slope is intercepted there is no deflection of the glide slope indicator, or the bar remains fixed, or the warning flag is visible, the ILS switch must be disengaged. The ILS approach (either normal or automatic) must not be made, as the ILS signals or indications are unreliable.

- If an automatic ILS approach is made after intercepting the localizer beam, the ILS switch on the AFCS panel must not be engaged if there is no deflection of either the bank steering bar or the course deviation indicator, or if the glide slope indicator does not have an upward deflection or if either the course warning flag or the glide slope warning flags on the ADI are in view.

- On dual flights when operating in the ILS mode do not transfer control from one cockpit to the other, as the aircraft will perform erratically in pitch and roll when the pilot taking over reengages the AFCS AUTOPLT and ILS switches.
- Do not depress the vertical gyro fast-erect button with ILS engaged as undesirable transients may occur.

Inbound Procedure.

Place the instrument selector switch at ILS-LCL after procedure turn to intercept the inbound localizer beam. Check to see that the course deviation indicator on the HSI and the bank steering bar on the ADI are operating, and that the glide slope indicator is visible on the ADI.

Note

The bank and pitch steering bars and the glide slope indicator are operative only when the steering bar (needle) switch is ON.

Establish the landing configuration and approach speed. Recommended maximum intercept angle of the localizer is 20 degrees at 8 miles to 50 degrees at 12 miles. The course arrow and course selector window of the HSI must be preset to the runway localizer course. The angle at which the aircraft is approaching the localizer course (runway heading) should be determined by observing the angular difference between aircraft heading and runway heading as indicated on the heading marker of the HSI, rather than by ground orientation means. This will insure that the unpegging of the course deviation indicator on the HSI will be seen, as described below. Intercept the localizer course and place the instrument selector switch at ILS FINAL. At this time the pitch steering bar on the ADI will come into view. (The pitch steering bar is out of view in all but the ILS-FINAL mode.) When the pitch steering bar is centered, the altitude of the aircraft for capture of the glide slope is correct, or the aircraft is on glide slope.

WARNING

Some aircraft are presently equipped with a combination of flight director computer and ADI which displays the pitch steering bar at all times. Any

WARNING (Continued)

indications that the pitch steering bar displays, except in ILS FINAL position of the instrument selector switch, are to be disregarded. In ILS FINAL position, the pitch steering bar supplies correct information.

During localizer interception when the course deviation indicator on the HSI unpegs (begins to move from the side of the HSI toward the center), wait a minimum of 2 seconds and then engage the AFSC/ILS switch.

Note

The control stick must be at its wings level trimmed position (no lateral force on stick) at the time of ILS switch engagement.

If the switch is engaged prematurely, prior to the course deviation indicator unpegging, the aircraft may not intercept and bracket the beam. Sufficient distance from the runway localizer beam should be allowed prior to ILS switch engagement (indicated by unpegging of the course deviation indicator). If the switch is engaged too late, the aircraft may pass through the center of the beam and come out on the other side. This may also prevent interception of the course. As the aircraft begins to bracket the localizer, the initial overshoot of the beam center can be as much as 100 percent of full scale deflection of the course deviation indicator. The maximum bank angle during intercept and bracketing should not be more than 30 ± 9 degrees. Automatic altitude-hold will be maintained until the glide slope is intercepted. When glide slope indicator of the ADI is approximately centered, the control stick will go forward slightly and the aircraft will assume, approximately, a 3-degree nose-down attitude. Airspeed will increase unless about a 5 percent reduction in RPM is made.

Note

Engage auto ILS a minimum of 1 NM prior to glide slope interception to allow sufficient time for the holding relay to disengage and allow normal glide slope interception. If the 17-second time holding relay disengages after glide slope interception, a hard-over signal may be experienced. Auto ILS system yields optimum performance at intercept altitude of 1500 feet above runway

elevation. Interceptions at substantially different altitudes (± 300 feet) may result in reduced performance and possible non-interception of glide slope beam.

From the outer marker to the end of the runway, the system will continue bracketing both the localizer and glide slope. AFCS bracketing corrections in pitch and roll will be reflected at the control stick. An acceptable system can be flown down to 200 feet above the ground at which time it must be disconnected by depressing the autopilot emergency disconnect lever on the control stick and the landing must be made manually. Touchdown cannot be made automatically as an automatic flareout feature is not incorporated in this system. When a go-around is anticipated, disengage the auto ILS mode by actuating the AFCS emergency disconnect lever. Stab-aug can then be reengaged. When initiating a go-around, the instrument selector switch is placed at ILS-LOCALIZER and the HSI and ADI will continue to display the aircraft position relative to the selected runway position and runway heading respectively.

WARNING

When flying an auto ILS the possibility of erratic roll maneuvers exists in response to localizer beam interruptions or disturbances due to aircraft or other vehicular traffic in the localizer antenna pattern.

Note

Force switch maneuvering is deactivated during the automatic landing operation.

- When in the automatic ILS mode, throttle control, landing gear and flap actuation, flareout, and landing, are made manually by the pilot.
- Throughout the approach, monitor the flight instruments and the attitude director indicator.

Outbound Procedure.

The outbound procedure is used during a go-around and occasionally during an initial procedure. When a decision to go-around is made, the emergency disconnect lever is depressed and the instrument

selector is placed at ILS-LOCALIZER. Continue the climb-out on the final approach heading, utilizing localizer signals for course deviation information. The aircraft, during the outbound procedure, is manually controlled by the pilot. When a procedure turn is made to fly the localizer on a reciprocal heading to the final approach heading, index the instrument selector switch to ILS-OUTBND and rotate the heading set knob on the HSI to the outbound heading of the ILS runway. In this mode, the bank-steering bar is slaved to the heading marker on the HSI and will command the proper angle of bank to turn to and maintain the selected heading. Rotate the course set knob on the HSI to the inbound localizer course. The course arrow and course deviation indicator on the HSI will display normal ILS information. Fly the outbound heading at recommended speed and altitude. Keep the bank-steering bar on the ADI centered to maintain the selected outbound heading. The relative runway position (on-course line) will be indicated by the course deviation indicator on the HSI. At the prescribed distance beyond the outer marker, execute a procedure turn as directed and descend to final approach altitude. Follow procedures for the INBOUND PROCEDURE.

Autoss Switch.

The autoss switch (figure 1-32) is a two-position toggle switch, spring-loaded to the OFF position with a solenoid-held AUTOSS position. The switch is used to set up the AFCS to receive signals from the Toss-Bomb Computer. The switch can be positioned to, and will remain engaged in, the AUTOSS position provided:

- Fire control system power switch to STBY or ON and either CTR or GRD MAP selected.
- ☐ • FLIGHT, WEAPONS, and RADAR control transfer (take-over) buttons engaged.
- Stab-aug button is engaged.
- Autopilot button is engaged.
- Weapon selector switch at SPECIAL WEAPONS or CONV BOMBS (EXT BOMBS).
- Bomb-mode selector switch in any radar or visual IP or TIP mode (BIP, BTIP, VIP, VTIP).
- Bomb/Nav switch at BOMB.

Note

With the master armament switch at WEAPONS, stores will be released. With the master armament switch at OFF or CAMERA, an AUTOSS maneuver can be flight tested, but stores (or bomblets) will not be released.

With the AUTOSS switch engaged and illumination of the SOLUTION and PULL UP light, depressing the freeze/fire button initiates an AFCS controlled automatic toss bomb maneuver (AUTOSS). When the pitch attitude is approximately 170 degrees, the aircraft will roll out to level flight on the reciprocal to the entry heading (± 15 degrees). If the freeze/fire button is released during the automatic pull-up before the store is released, the store will not release, but the maneuver will be completed, however in this condition ensure that airspeed is above 200 KCAS before roll-out. Allow the aircraft nose to descend through the horizon and initiate a slow recovery. (If the bomb-bay station was selected, the bomb-bay doors will close.) Actuation of pitch or roll force switches has no effect on the maneuver, however, automatic trim is interrupted while a force switch is actuated and also when accelerations are below 0 and above 2.5 Gs. Upon completion of the maneuver, the AFCS reverts to altitude and heading-hold, and AUTOSS should be disengaged with the autopilot emergency disconnect lever. Although the autoss switch or autopilot button will disengage autoss, the autopilot emergency disconnect lever should be used to disengage all AFCS functions. Stab-Aug and pilot relief may be engaged immediately, providing the aircraft attitude is within engaging limits.

Automatic Toss Bomb Maneuver.

Note

The AUTOSS delivery shall not be performed with aircraft carrying asymmetrical loads. See section VI.

To prepare for an automatic toss bomb maneuver, set control transfer, AFCS, and fire control system switches as noted above.

- If maneuvers or accelerations have occurred before entering the bomb run, the vertical gyro must be fast erected to cancel out gyro errors. To erect, stabilize the aircraft in altitude-hold at a constant airspeed with the steering needle

switch ON. Depress and hold the vertical gyro fast-erect button until the pitch steering bar on the ADI is lined up within 4 bar widths of the miniature aircraft (altitude-hold is interrupted while the gyro fast-erection button is depressed). Release the gyro fast-erect button and continue to maintain constant airspeed and altitude for an additional 15 seconds to permit gyros to slow erect.

CAUTION

Do not hold the vertical gyro fast erection button depressed continuously over 30 seconds, and allow a 90-second interval between each use for cooling of the slew motors and electrolytic switches.

Note

The bomb mode selector switch should not be in the DIVE position during the erection cycle as the pitch steering bar on the ADI will not give proper indication.

Any pilot relief function other than Mach-hold will automatically re-engage 2 seconds after release of the gyro fast-erect button. Depress the autopilot button if not engaged during the fast erection, and engage the autoss switch.

- Begin AUTOSS maneuver at a minimum of 545 knots CAS, at a maximum altitude of 5000 feet above sea level for a gross weight of 36,000 to 40,000 LBS, and a maximum altitude of 10,000 feet for a gross weight of 36,000 LBS or under.
- An AUTOSS may be initiated with military power, however, when the aircraft reaches 40 degrees of pitch and the store has not released the maneuver may be continued if afterburner is ignited and the AUTOSS maneuver will complete over the top. If the maneuver is to be discontinued depress the AFCS emergency disconnect lever and manually perform a 4G wingover.
- With heavy gross weights, extreme care must be exercised not to exceed the limitations stated in section V.

- At appropriate time, depress and hold the freeze/fire button while flying straight and level with feet off the rudder pedals (AUTOSS will not commence if a yaw force switch is actuated although autoss switch will remain engaged). When either the SOLUTION light or HI-TOSS PULL UP light illuminates, a pull up signal is received by the AFCS and the control stick will move aft for the automatic toss. The AFCS autoss maneuver is a controlled constant 6-degree per second pitch rate pull-up initiated by a fire control interlock in the IP and TIP bombing modes. A peak of approximately 4.0 to 5.3 Gs may be experienced during the pull-up at 40 to 75 degrees in the flight path.

Note

The criterion for an acceptable autoss maneuver should be a smooth pull-up with sufficient airspeed over the top for a safe roll-out. Light buffeting may be experienced during this maneuver.

Wings level will hold within plus or minus 3 degrees of the reference lock-on during pull-up. At approximately 170 degrees, the control stick will move rapidly to full left deflection and a 180-degree roll will commence. As the wings approach level with the aircraft right side up, the stick will move rapidly about one-half right deflection and then center as the wings reach level. When the aircraft is level, the AFCS automatically locks onto altitude and heading-hold. Roll-out heading should be within plus or minus 15 degrees of the reciprocal entry heading. When using the afterburner, the aircraft goes over the top at approximately 20,000 feet if the entry was at 5000 feet and Mach 0.9. It takes about 35 pounds of stick force for minor corrections to overpower the AFCS during this maneuver, so if malfunction occurs, the emergency AFCS disconnect lever should be depressed to return control of the aircraft to the pilot. After completing the maneuver, shut off the afterburner before the aircraft goes into the transonic speed regime. Roll and pitch force switch maneuvering is deactivated during this mode.

Note

The autoss function should be disengaged at completion of the toss bomb maneuver by depressing the emergency disconnect lever; otherwise, undesirable transients may occur if the AUTOSS switch is used for disengagement.

- The gun can be fired when the master armament switch is in the WEAPONS position, and the GUN CONTROL circuit breaker is IN. Refer to BOMBING in this section for procedures using AUTOSS during actual store or bomblet release.
- In solution anticipation mode of the TBC, the AUTOSS maneuver will initiate upon illumination of the solution light while the freeze/fire button is depressed only in VTIP mode. In the BIP, BTIP, or VIP modes, the AUTOSS maneuver will initiate upon illumination of the High-Toss pull-up light while the freeze/fire button is depressed. In the normal solution mode of the TBC, the AUTOSS maneuver will initiate upon illumination of the solution light while the freeze/fire button is depressed in all modes (VTIP, VIP, BTIP, and BIP). In the retarded mode of the TBC the AUTOSS maneuver will not initiate in any bombing mode.

Manual Toss Bomb Maneuver.

Note

A manual controlled over the top maneuver (VTIP or BTIP) may be performed with military power if the entry speed is greater than 575 KTAS.

A pilot-controlled manual toss-bomb maneuver may be accomplished with automatic wings level corrections provided by the AFCS. The AFCS, and fire control (and control transfer in the ☐) switches must be set as follows:

- ☐ • FLIGHT and WEAPONS control transfer (take-over) buttons engaged.
- Stab-aug button engaged.
- Autopilot button engaged.
- Fire control system power switch at STBY or ON, and either GRD MAP SPOIL, GRD MAP PENCIL, or CTR MAP selected.
- Bomb mode selector in any position except DIVE, MANUAL, or TIMER.

- Weapons selector at SPL WPN or CONV BOMBS (EXT BOMBS).
- Master armament switch at WEAPONS (only necessary for bomb release, not necessary for flight test).
- Bomb/Nav switch at BOMB.
- Range wind set at AUTO or MANUAL.

When the SOLUTION and HIGH-TOSS PULL-UP light is illuminated and the freeze/fire button is depressed (provided yaw force switches are not activated and the aircraft is within 10 degrees of wings level), automatic wings level will be supplied by the AFCS after the aircraft has been manually pulled up to a pitch angle greater than 10 degrees. The yaw force switches are not active during the automatic wings level maneuver. Roll force switch maneuvering is deactivated during the automatic wings level maneuver only while the freeze/fire button is depressed. After the freeze/fire button is released and a roll force switch is actuated, the automatic wings level function becomes inoperative and the AFCS reverts to the pilot relief mode.

Dive Bomb Maneuver.

A pilot-controlled dive-bomb maneuver may be accomplished with automatic wings level correction provided by the AFCS. The AFCS and fire-control switch positions must be the same as those used for the Manual-Toss Bomb Maneuver with the exception of the bomb mode selector switch which must be at DIVE. When the SOLUTION light is illuminated and the freeze/fire button is depressed (provided yaw force switches are not activated and the aircraft is within 10 degrees of wings level), automatic wings level will be supplied by the AFCS immediately.

AFCS-SIGHT-SYSTEM TIE-IN.

Provided the weapons selector switch is placed at MISSILES-AIR, the AFCS will provide the sight sub-system with an indication of normal acceleration in excess of 2.25 Gs. This is shown on the sight combining glass by a G-limit flag covering the six o'clock index of the reticle. Stab-aug or autopilot does not have to be engaged for this operation.

AFCS SYSTEM CHECK.**Preflight.**

Refer to section II of this manual for checks of the AFCS.

FIRE CONTROL SYSTEM.

The Thunderstick fire-control system (AN/ASG-19), designed specifically for fighter bomber use, is an integration of the R-14 radar system, the attack-and-displays system, and the toss-bomb-computer subsystem. The fire-control system also provides functions for use in other aircraft systems for navigational purposes. The completely integrated systems provide the following all-weather capabilities.

NAVIGATION.

- Ground mapping (pencil or spoil)
- Contour mapping
- Terrain avoidance
- Doppler radar fix

BOMBING.

- Visual dive toss (Radar or pressure (CADC) ranging)
- Visual identification point (VIP)
- Visual target identification point (VTIP)
- Radar identification point (BIP)
- Radar target identification point (BTIP)
- Manual—used if fire-control system is inoperative
- Timer—(timed manual run) used if TBC is inoperative and/or timed manual retarded weapon delivery

AIR-TO-GROUND ATTACK (SRCH ATK) VISUAL ONLY.

- Air-to-Ground ranging
- Guns — Ground
- Rockets — Ground
- Missiles — Ground

AIR-TO-AIR ATTACK (SRCH ATK).

This mode consists of searching, acquiring, and tracking a target.

- Visual guns — Air
- Visual missiles — Air
- Radar guns — Air
- Radar missiles — Air, co-altitude
- Radar missiles — Air, snap-up

Note

For description of the Thunderstick fire-control system (AN/ASG-19) pertaining to non-nuclear weapons delivery, refer to T.O. 1F-105B-34-1-1. For nuclear weapons delivery, refer to T.O. 1F-105D-25-1, -2, or -3.

During a dual mission in the [E] when either pilot wants full command of the Fire-Control System, he should engage both the RADAR and WEAPONS take-over buttons. If only one button is depressed, he would have command only of that particular function. Refer to the Take-Over System in section I, and the R-14 Radar System in this section for details on these buttons.

RADAR SYSTEM-R-14.

The R-14 radar system is an integral part of the fire-control system. It is a monopulse, X-band radar powered by AC and DC secondary power. The system provides information to the toss-bomb computer and the attack-and-display subsystems (sight and radar scope).

Radar Control Transfer (Take-Over) Buttons and [E] Indicating Lights.

The radar control transfer (take-over) button in each cockpit (figure 1-62), permits transfer of radar control between cockpits. The take-over buttons are solenoid-held pushbutton switches placarded RADAR, and pressing the button in either cockpit transfers control of the radar system to that cockpit. The following controls are operative in the cockpit with RADAR control: Fire-control system power switch, mode selector buttons, clearance plane set switch, antenna tilt control, radar gain control, horizon center knob, altitude set knob, clearance calibration

knob, clutter eliminator switch, sight electric cage/range cursor button, radar action reject button and resume search/range gate operation (throttle grip). The following controls are operative in both cockpits regardless of which cockpit has control and must be individually set if required: Video pedestal knob, cursor brilliance knob, memory knob, intensity knob, bezel brilliance knob, mode lights, clearance plane indicator, red filter light knob, antenna tilt indicator and range lights. The take-over button in each cockpit contains an integral legend type indicator light which illuminates and displays NO CONTROL in the cockpit that does not have control of the radar set. The buttons holding and transfer circuits are powered by the DC secondary power and the lights are powered by AC primary power. When power is initially applied to the aircraft, all take-over buttons are up; however, the forward cockpit has control and the aft cockpit buttons are illuminated displaying NO CONTROL. Brightness of the indicator lights (buttons) is controlled by the FLIGHT INST control on the interior lights panel in each cockpit.

Note

- [F] To prevent loss of electrical power to the radar system during a take-over, the fire-control system power switch in the cockpit taking over control of the radar system must be at STBY or ON. If this is not done before depressing the RADAR take-over button, the radar system will switch off and radar information and displays in both cockpits will be lost. The radar system will then require approximately 5 minutes for recycling after an interruption of power.
- [F] • When taking over control of the radar system, radar mode controls and the system power switch in both cockpits must be compatible to prevent loss of and change in displayed information.
- [F] • For take over of the full fire control system both the RADAR and WEAPONS take-over buttons should be depressed at the same time.

Fire-Control System Power Switch.

The fire-control system power switch (figure 1-34) on the radar system control panel (left-hand console) is a three-position toggle switch placarded SYSTEM POWER. The switch positions are

placarded STBY (standby), and OFF. The ON position is not placarded and is used to energize the entire fire control system. The STBY position is used to energize the fire control system with the exception of the radar transmitter. The OFF position shuts off all power to the entire fire control system. To go from STBY to OFF it is necessary to raise the switch. In navigational modes, the toss-bomb computer is not operative except during a Doppler fix. When flying dual in the [F] if the pilot in the front cockpit is in command of the fire control system, and the pilot in the rear cockpit, wants to take over control of the radar (or vice versa) he must have the fire control system power switch at STBY or ON. This will prevent radar switch-off when the pilot in the other cockpit takes over control of the system.

Radar Scope.

The radar scope (figure 1-34) is a 5-inch storage type cathode tube located in the lower center of the main instrument panel. An engraved transparent scale over the face of the scope defines the display area range markers and range scale. The scope is illuminated and the engraved scale visible when the fire control system power switch is in the STBY or ON position.

Rear Cockpit Radar Scope Deactivate Switch. [F]

The rear cockpit radar deactivate switch (28, figure 1-7) (not in rear cockpit) is a two-position switch with positions placarded DEACTIVATE AFT RADAR SCOPE and NORM. The switch is used to deactivate the rear radar scope during radar maintenance checks in the front cockpit, and when flying solo to prolong the life of the rear scope. It can also be used to deactivate the rear scope to simulate radar failure during a radar training flight. When the switch is at NORM and the radar system is ON, both front and rear scopes present the display mode selected by the cockpit in control. When the switch is at DEACTIVATE AFT RADAR SCOPE, the rear scope is inoperative. The switch controls high voltage to the rear radar scope.

Radar Scope Controls.

Red Filter Knob. The red filter knob (figure 1-34) immediately below the radar scope, is placarded RED, with arrows indicating clockwise rotation. Rotating the knob clockwise rotates a filter glass over the face of the scope and increases the redness of the indicator display.

Video Pedestal Knob. The video pedestal knob (figure 1-34) is placarded VIDEO PEDESTAL. The knob

RADAR SCOPES and controls

SCOPE SHOWN ILLUMINATED FOR INFORMATION ONLY

D & F FRONT

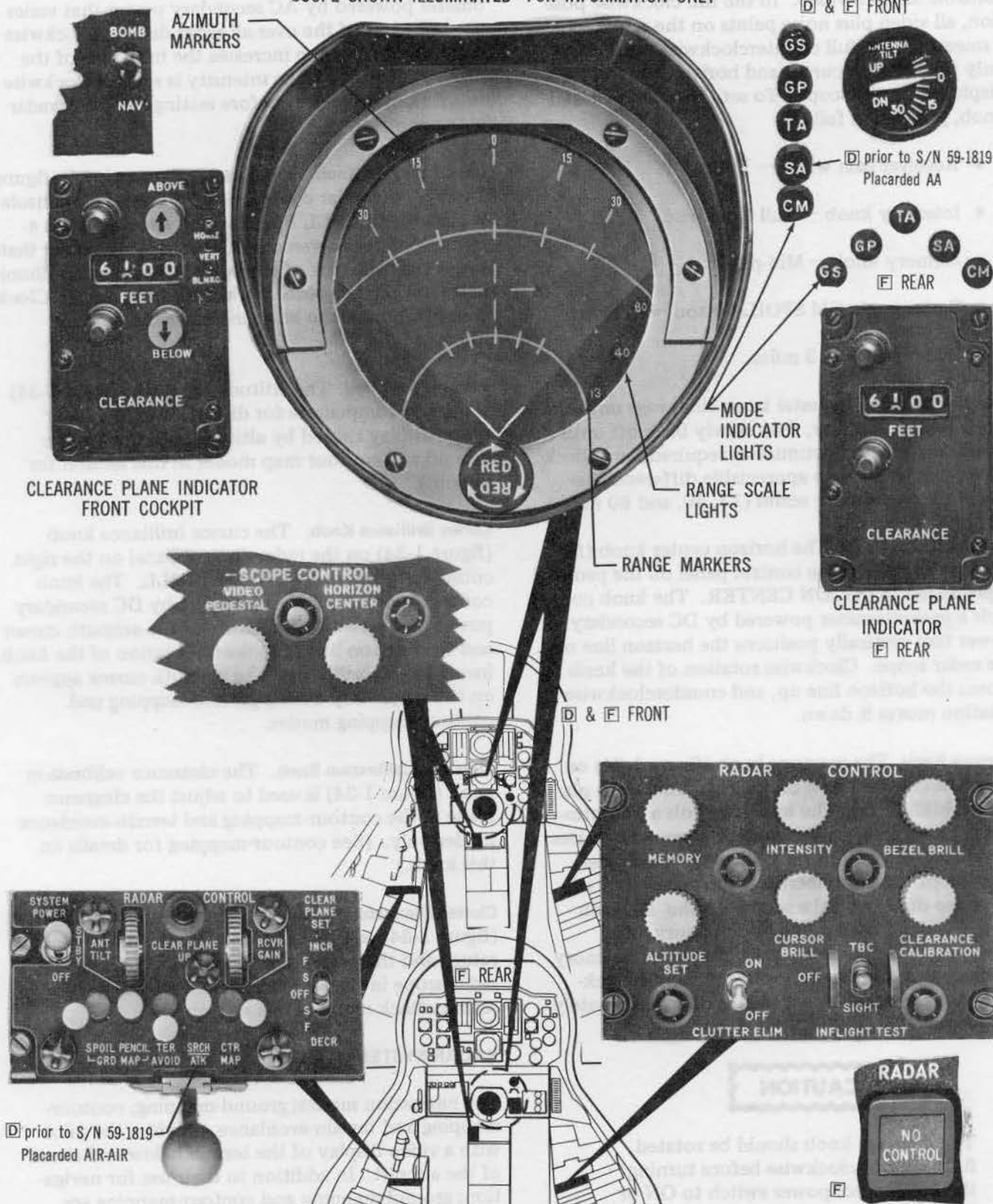


Figure 1-34

controls a potentiometer, powered by DC secondary power, which varies the amount of video that appears on the scope. In the [E] each crew member controls his own video. In the full clockwise position, all video plus noise paints on the scope causing a smear. In the full counterclockwise position, only the azimuth cursor and horizon bar will be displayed on the scope. To set the video pedestal knob, proceed as follows:

- Receiver gain wheel — Full AFT.
- Intensity knob — Full clockwise.
- Memory knob — Mid-position.
- Radar mode GM SPOIL button — Depress.
- Range scale — 13 miles.

Rotate the video pedestal knob clockwise until the scope begins to smear, then slowly back off until smear disappears. Optimize as required, and check to see that there is no appreciable difference between the three range scales (13, 40, and 80 miles).

Horizon Center Knob. The horizon center knob (figure 1-34) on the scope control panel on the pedestal is placarded HORIZON CENTER. The knob controls a potentiometer powered by DC secondary power that vertically positions the horizon line on the radar scope. Clockwise rotation of the knob moves the horizon line up, and counterclockwise rotation moves it down.

Memory Knob. The memory knob (figure 1-34) on the radar control panel on the right console is placarded MEMORY. The knob controls a potentiometer powered by AC secondary power that varies the persistency of the video display. Clockwise rotation of the knob increases the persistency of the video display on the scope. In the [E] each crew member controls his own memory. Full clockwise rotation of the knob provides a memory of approximately 3 seconds. Full counterclockwise rotation provides a memory of approximately 0.5 second.

CAUTION

The memory knob should be rotated fully counterclockwise before turning the fire control power switch to ON or STBY. This will prevent scope blooming and possible scope damage.

Intensity Knob. The intensity knob (figure 1-34) on the radar control panel on the right console is placarded INTENSITY. The knob controls a potentiometer powered by AC secondary power that varies the brilliance of the over-all radar display. Clockwise rotation of the knob increases the brilliance of the display. Normally, the intensity is set full clockwise (maximum brilliance) before setting the other radar scope controls.

Bezel Brilliance Knob. The bezel brilliance knob (figure 1-34) on the radar control panel on the right console is placarded BEZEL BRILL. The knob controls a potentiometer powered by DC secondary power that varies the brilliance of the bezel lighting which illuminates the edge-lit bezel markings on the scope. Clockwise rotation of the knob increases the lighting intensity.

Altitude Set Knob. The altitude set knob (figure 1-34) is used to compensate for distortion in the radar scope display caused by altitude variations. (See ground and contour map modes in this section for details.)

Cursor Brilliance Knob. The cursor brilliance knob (figure 1-34) on the radar control panel on the right console is placarded CURSOR BRILL. The knob controls a potentiometer powered by DC secondary power that varies the brilliance of the azimuth cursor and the horizon line. Clockwise rotation of the knob increases the brilliance. The azimuth cursor appears on the scope only during ground-mapping and contour-mapping modes.

Clearance Calibration Knob. The clearance calibration knob (figure 1-34) is used to adjust the clearance plane in the contour-mapping and terrain-avoidance modes only. (See contour-mapping for details on this knob.)

Clutter Eliminator Switch. The clutter eliminator switch (figure 1-34) is used to reduce ground-clutter, sea return and the presence of jamming signals on the radar scope in the search attack mode only. (See search attack mode in this section.)

RADAR SYSTEM MODES.

The navigation modes; ground-mapping, contour-mapping and terrain-avoidance, provides the pilot with a video display of the terrain below and ahead of the aircraft. In addition to their use for navigation; ground-mapping and contour-mapping are used in radar bombing to identify targets, identification points, or prominent terrain features, and

provide range information to the toss-bomb computer. The system will switch from terrain-avoidance to contour-map when the bomb-Nav switch is placed at BOMB. During a visual dive-bombing run, the radar provides ranging information to the attack-and-displays subsystem. The search-attack modes are used for air-to-air attack with guns and missiles and supplies search, target acquisition, and tracking functions in air-to-ground attack, with guns, rockets, and missiles. The radar provides ranging information to the attack-and-displays subsystem as it does during the dive-bombing mode. Except for ground-mapping, all information presented on the radar scopes also appears on the sight combining glass (not in rear cockpit). The radar system mode is selected by pushbuttons which program the radar system for specific functions. Pushbuttons select specific modes and are appropriately placarded.

The pushbuttons are interlocked to prevent selection of more than one mode at a time. The mode in which the system is operating is indicated by the illumination of one of five mode indicator lights except when the terrain avoidance mode is selected and the Bomb/Nav switch is in bomb. In this case the T/A light will be illuminated but the system will be operating in the Contour Map Mode. The lights are located on the main instrument panel at the right side of the radar indicator (figure 1-34).

Note

When operating in the ground-mapping, contour-mapping or terrain-avoidance mode on aircraft [1050] C/W, and the weapons selector knob is in any position except GUNS AIR or MISSILES AIR, the radar system will automatically transfer to search/attack mode and the fire-control system will transfer to guns air-to-air if the radar action reject button is depressed and released. The button continues to perform its present guns air-to-air functions. The search/attack mode light will illuminate. To return the radar and fire-control systems to the preselected modes, the weapons selector knob is positioned to GUNS AIR or MISSILES AIR and returned to the preselected position.

CAUTION

During night takeoffs, insure that radar is not in the search attack mode.

Ground Map Spoil Mode. The ground map spoil mode presents a 90-degree sector display of the terrain ahead of the aircraft in scale ranges of 80, 40, or 13 nautical miles. Illumination of range scale numbers on the radar scope indicates the scale selected. Superimposed on the display is a range cursor used as a reference slant range mark during a bombing attack. The slant range may be changed from 60 to 40 to 30 thousand feet. An azimuth cursor is automatically positioned by the toss bomb computer by a function of drift angle based on Doppler inputs. This drift angle positioning is eliminated when the Doppler is turned OFF or the Bomb/Nav switch is in the BOMB position with the range wind switch at MANUAL. The azimuth cursor is also positioned automatically by the toss bomb computer for offset in the BIP mode when the Bomb/Nav switch is at BOMB. A horizon line is automatically positioned by the aircraft pitch and roll computers. The antenna beam scans the ground ahead of the aircraft in a pattern 90 degrees in azimuth and 55 degrees in elevation, and is stabilized in roll and pitch. The pilot can vary the antenna beam up 20 degrees, and down 38 degrees, from the armament datum line to locate targets. The area and intensity of radar return is dependent upon the height of the aircraft above the terrain and the antenna tilt angle. (See figure 1-35.)

Ground-Map-Spoil Mode Button. The ground-map-spoil mode button (figure 1-34) is a two-position push-button switch placarded GRD MAP-SPOIL. When the button is depressed, the radar system is placed in the ground-map-spoil mode.

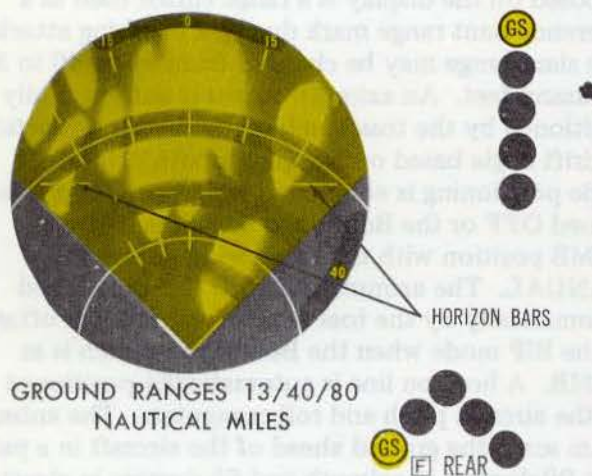
Ground-Map-Pencil Mode. The ground-map-pencil mode is the same as ground-map-spoil mode except the display will show fewer targets, but they will have higher definition. (See figure 1-35.) This is because the antenna beam vertical spread is reduced from 55 degrees to 6.2 degrees.

Ground-Map-Pencil Mode Button. The ground-map-pencil mode button (figure 1-35) is a two-position push-button placarded GRD MAP-PENCIL. When the button is depressed, the radar system is placed in the ground-map-pencil mode.

Range Scale/Nose Wheel Steering Button. This pushbutton (figure 1-27) located on the control stick grip is used to switch and illuminate range presentations on the radar scope and the sight combining glass. Consecutive depressions of this button produce scales of 80, 40 and 13 miles in ground mapping, and 40 and 13 miles in all other modes. (Only the 40 and 13 miles range lights are on the right side of the combining glass (not in rear cockpit). With the

GROUND MAP modes

SPOIL MODE

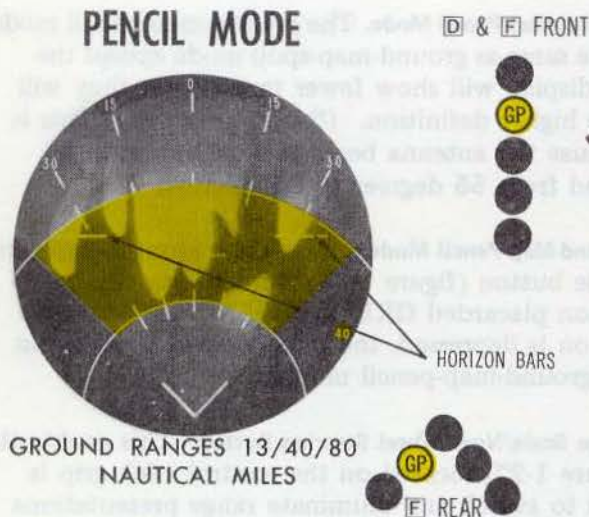


NOTE

For clarity, the range and azimuth cursors are not shown, and altitude set is not adjusted.

From 0 to 4 blank areas (no radar return) may appear when in the 40 and 80 mile range.

PENCIL MODE



NOTE

For clarity, the range and azimuth cursors are not shown, and altitude set is not adjusted.

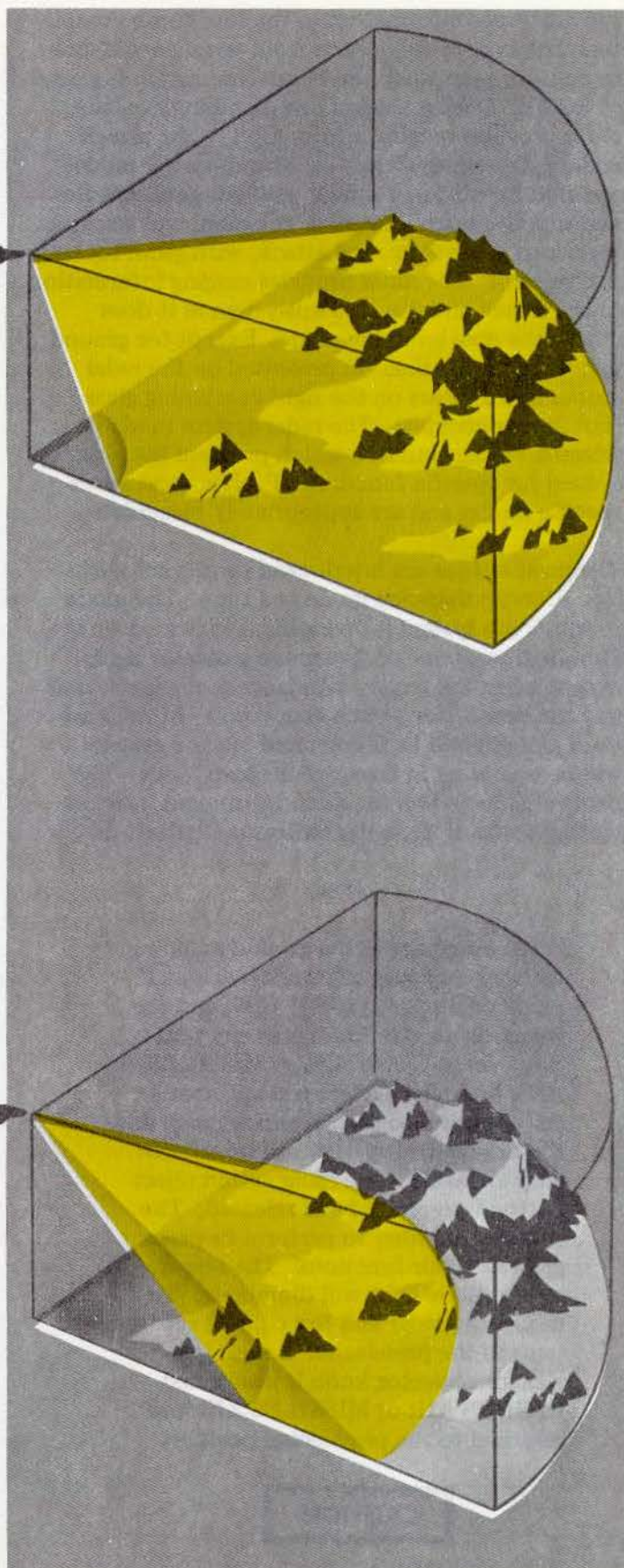


Figure 1-35

landing gear down and the aircraft weight on the gear, the nose wheel steering system is also activated when this button is depressed and held.

Radar Scope Range Lights.

80-Mile Range Light. The 80-mile range light (figure 1-34) located on the radar scope face displays the numeral 80. Illumination of this light indicates the presence of an 80-mile display on the radar scope. The light is powered by AC primary power.

40-Mile Range Light. The 40-mile range light (figure 1-34) located on the radar scope face and to the right of the combining glass (not in rear cockpit) displays the numeral 40. Illumination of this light indicates the presence of a 40-mile display on the radar scope and sight combining glass. The light is powered by AC primary power.

13-Mile Range Light. The 13-mile range light (figure 1-34) is located on the radar scope face and to the right of the combining glass (not in rear cockpit) and displays the numeral 13. Illumination of the light indicates the presence of a 13-mile display on the radar scope and combining glass. The light is powered by AC primary power.

Sight Electric Cage/Range Cursor Button. This contact pushbutton (figure 1-26) is located on the control stick grip. In the bombing or navigation modes, the button is operative as a range cursor button and with each momentary depression of the button (in the **F**, in the cockpit with control of the radar system) the setting of the range cursor on the radar scope changes from 60, to 40, to 30 thousand feet representing slant ranges. The range scale can be at the 80-, 40-, or 13-mile ranges and the range cursor, which is superimposed on the radar display will show the 60, 40 or 30 thousand foot distances proportionately, on the chosen range scale mileage display. With the SRCH ATK radar mode button engaged, the button is operative as a caging control (not operative in the rear cockpit of the **F** in this mode). In the search attack mode (sight uncaged, and reticle on the combining glass), with the weapons selector knob at GUNS AIR, GUNS GROUND or RKT-AUX STORES and the aircraft in unaccelerated flight, depressing the sight electric cage button will align the reticle pipper to the armament datum line (ADL). If turning rates are then introduced to the aircraft, the reticle pipper will then be displaced as a function of turning rate only, as derived from the lead computing gyro (± 12 MILS MAX).

Note

When this button is depressed the electrical caging current induces a lead angle computation approximating that of 750 feet of range.

Radar Gain Control. The radar gain control (figure 1-34) is a thumbwheel, located on the left console which is marked RCVR GAIN. The thumbwheel controls a potentiometer which varies the sensitivity or the amount of video return displayed on the radar scope in ground-map modes only. Forward rotation of the wheel increases the sensitivity or gain of the receiver. The control is powered by DC secondary power.

Altitude Set Knob. The altitude set knob (figure 1-34) is marked ALTITUDE SET and is used to position the distance from the apex of the radar scope at which ground-map and contour-map display begins, thus indicating true ground range. (This distance or altitude return is a function of aircraft altitude above terrain and antenna tilt angle, and must be minimized to produce an undistorted horizontal projection of the ground-map display.) In the ground map modes the knob should be adjusted each time a change is made in aircraft altitude, so that the radar return apex is placed exactly under the bezel apex. This assures that azimuth and range readouts are correct. Correct procedure is to rotate the knob to position the radar return apex about an inch toward the center of the scope then reverse rotation and move the radar return apex down. With the Bomb/Nav switch at BOMB and the bomb mode selector knob at BIP or BTIP the altitude set knob is inoperative, and altitude set is automatic (supplied from the TBC). To display true ground speed on the radar scope proceed as follows:

- Antenna tilt — Full Forward.
- Receiver gain — Full Forward.
- Range scale — 13 Miles.
- Bomb/Nav switch — NAV.
- GRD MAP SPOIL button — Depress.

Maintain desired altitude, and note presence of the altitude hole on the scope. Adjust the altitude set knob until the radar scan apex coincides with the scope apex. The video displayed on the scope is now indicating true ground range. Whenever altitude is changed in the NAV mode, the altitude set must be adjusted.

Antenna Tilt Wheel. The antenna tilt thumbwheel (figure 1-34) marked ANT TILT controls the elevation positioning of the antenna in the ground-mapping or search attack mode. It varies the elevation angle of the antenna up 20 degrees to down 38 degrees. In the ground-map and contour-map mode, the elevation angle is oriented to the horizontal. In the search/attack mode it is oriented to the ADL; and in the terrain avoidance mode it is oriented to the aircraft flight path. The tilt, is manually selected to optimize the target return. The wheel is powered by AC secondary power.

Antenna Tilt Indicator. The antenna tilt indicator (figure 1-34) located on the main instrument panel contains a needle and a scale graduated in 5 degree increments. The upper scale reads a maximum of 15 degrees up and the lower 30 degrees down. The indicator is powered by DC secondary power.

Contour-Map Mode. The contour-map mode (figure 1-36) presents a 90-degree sector display of terrain ahead of the aircraft above a selected clearance plane. A clearance plane from 0 to 6000 feet below the aircraft may be selected. *The clearance plane is parallel to true horizon (all attitude gyro signals) at all times.* Only those surface features that have sufficient terrain elevation to project into the clearance plane and antenna beam appear on the radar scope. Range scales of 13 or 40 nautical miles may be selected. Refer to figure 1-37 for effective range. Range and azimuth cursors and a horizon line are provided as in ground-map operation. Contour-mapping is extremely useful for correction of aircraft drift, determination of landmark heights, and radar let-downs on fields surrounded by mountainous terrain.

WARNING

Use extreme caution when flying to Contour-Map and Terrain-Avoidance clearance plane settings of less than 1000 feet if visual contact with the ground is not maintained at all times. The gyro accuracy in pitch does not guarantee clearance.

Contour-Map Mode Button. The contour-map mode button (figure 1-34) is a two-position pushbutton switch placarded CTR MAP. When the button is depressed, the radar system is placed in the contour-map mode.

Clearance Plane Up Button. The clearance plane up button (figure 1-34) located on the left console is placarded CLEAR PLANE UP. This button is deactivated and should not be used.

Clearance Plane Set Switch. The clearance plane set switch (figure 1-34) is a five-position spring-loaded to the center (OFF) position type switch, and marked CLEAR PLANE SET, INCR and DECR. The switch contains five positions marked F and S on the increase side, OFF, and S and F on the decrease side. It is used to slew the clearance plane setting up or down (within 0 to 6000 feet below the aircraft) with either a slow (S) or fast (F) slewing rate. In the  this switch is active only in the cockpit with control of the radar system. The switch is powered by DC secondary power.

Clearance Plane Indicator.  The clearance plane indicator in the front cockpit and the clearance plane indicator follower in the rear cockpit (figure 1-34) numerically shows the clearance plane in feet (from 0 to 6000) set into the radar system when in contour-map or terrain-avoidance modes. Illumination of the front cockpit indicator arrow light has been deactivated. The rear cockpit indicator follower does not have indicator arrows. The clearance plane read on the rear cockpit indicator follower shall be within ± 50 feet of the reading on the front cockpit indicator. The indicator and indicator follower are powered by AC and DC secondary power.

Clearance Plane Indicator.  The clearance plane indicator (figure 1-34) numerically shows the clearance plane in feet (from 0 to 6000) set into the radar system when in contour-map or terrain avoidance modes. The indicator contains an arrow which illuminates when the clearance plane is set below the aircraft. The indicator is powered by AC and DC secondary power.

Clearance Calibration Knob. The clearance calibration knob (figure 1-34) on the radar control panel on the right console is placarded CLEARANCE CALIBRATION. Rotating the knob counterclockwise from stop to stop increases antenna tilt 5 degrees down. It is used as a fine setting, using known topographical altitudes for the antenna tilt after a clearance plane has been chosen for terrain-avoidance or contour-map modes. The circuit is powered by DC secondary power.

Altitude Set Knob. See Ground-Map Mode.

Contour-Map Calibration and Accuracy Check.

For contour-map calibration and accuracy check, refer to Terrain-Avoidance Calibration and Accuracy

CONTOUR MAP **mode**

NOTE

THE CLEARANCE PLANE INDICATOR SHOWN IS FOR THE FRONT COCKPIT.

For clarity, the range and azimuth cursors are not shown, and altitude set is not adjusted.

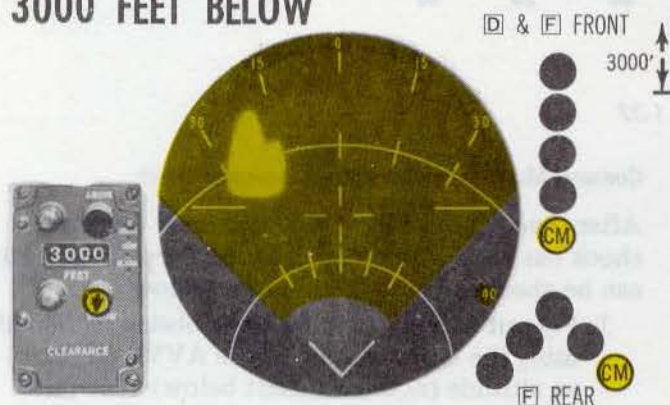
CLEARANCE PLANE PARALLEL TO TRUE HORIZON

GROUND RANGE 13 OR 40 NAUTICAL MILES

CLEARANCE PLANE SETTING 0 FEET BELOW



CLEARANCE PLANE SETTING 3000 FEET BELOW



CLEARANCE PLANE SETTING 6000 FEET BELOW

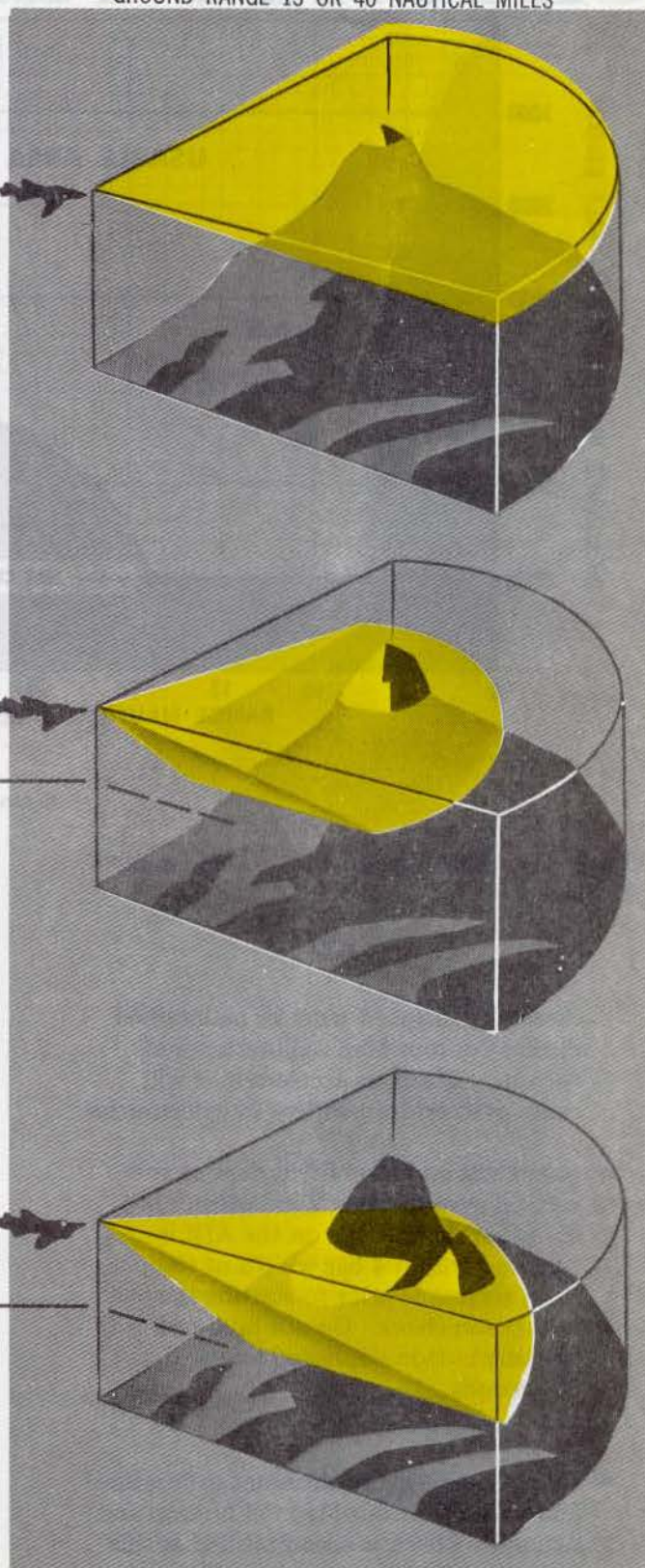
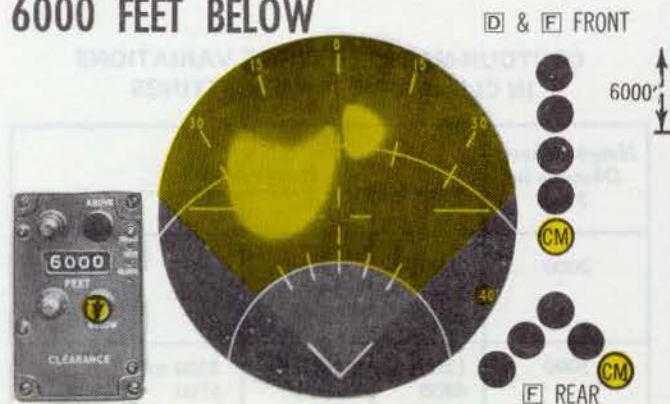


Figure 1-36

CONTOUR MAP MODE

effective range

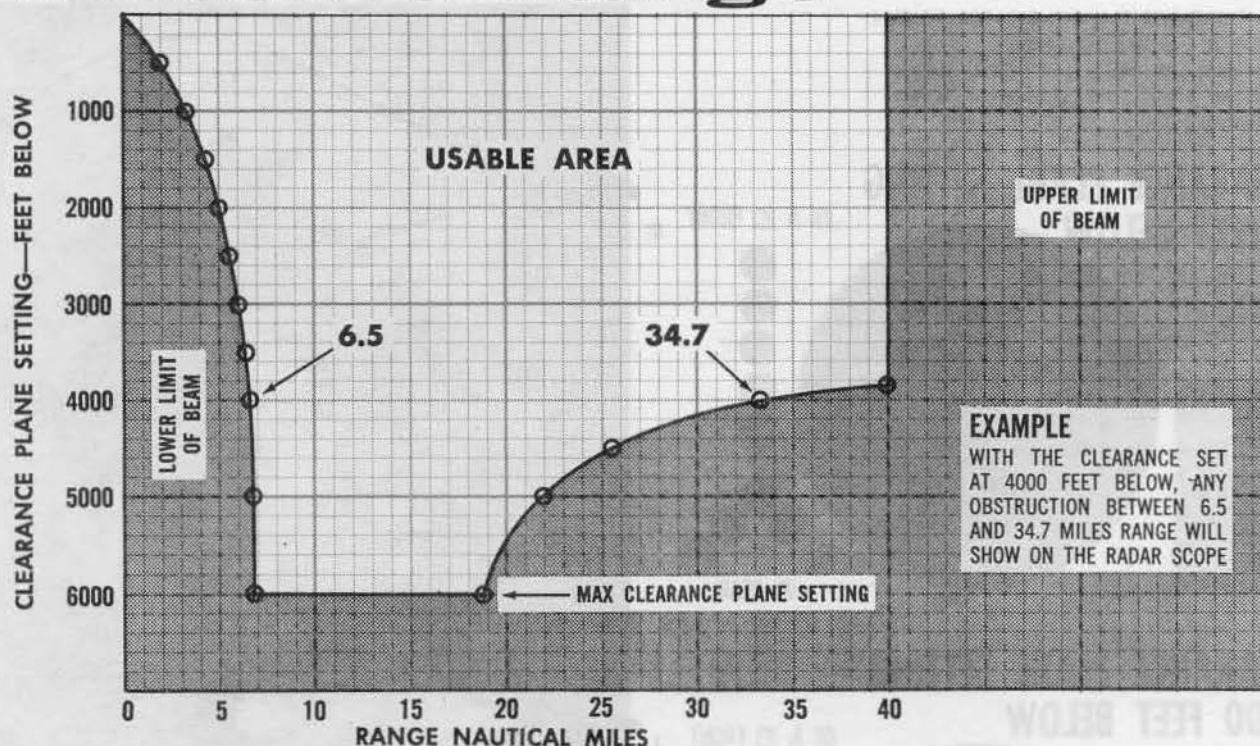


Figure 1-37

Check over Flat Terrain "or" Over Isolated Mountain.

Note

Stabilized airspeed must be maintained during Contour-Map Calibration and Accuracy Check as accelerations will cause gyro errors resulting in inaccuracies.

- In straight and level flight depress the vertical gyro fast erection button until the pitch steering bar on the ADI is centered within 4 bar widths of the fixed reference prior to starting the calibration check. Do not hold fast erection button depressed longer than 30 seconds.
- Do not readjust the clearance calibration knob after Contour-Map Calibration and Accuracy Check is accomplished as this may reposition the antenna and thereby affect system accuracy.

Contour-Map System Precision Accuracy Check.

After the Contour-Map Calibration and Accuracy check has been completed, precision system accuracy can be checked by performing the following:

1. Fly out at least 20 miles from obstruction, and using the altitude scale of the AVVI, climb to an altitude (noted on chart below) above the obstacle. Turn inbound and perform a data run, recording clearance plane settings at the specific points.

CONTOUR-MAP ALLOWABLE VARIATIONS IN CLEARANCE PLANE SETTINGS

Height Above Obstacle in Feet	Range in Miles			
	25	10	6	5
2000	200 to 3800 feet	1200 to 2800 feet		1400 to 2600 feet
3000	1200 to 4800 feet	2200 to 3800 feet	2300 to 3700 feet	

2. Stabilize airspeed (should not vary more than 1 knot every 5 seconds) and altitude. In straight and level flight depress the vertical gyro fast erection button until the pitch steering bar on the ADI is centered within 4 bar widths of the fixed reference prior to starting the calibration check. Do not hold the fast erection button depressed longer than 30 seconds. Maintain stabilized speed for remainder of check run.
3. Adjust clearance plane setting until obstacle just appears on the scope. Satisfactory performance is indicated when readings are within limits in table.
4. During this test, airspeed and altitude must be stabilized as aircraft acceleration will cause gyro errors resulting in contour-map inaccuracies.

Terrain-Avoidance Mode.

The terrain-avoidance mode (figure 1-38) presents a 90 degree sector display of the terrain ahead of the aircraft above a selected clearance plane. A clearance plane from 0 to 6000 feet below the aircraft may be selected. *The clearance plane is maintained parallel to the aircraft flight path at all times.* Only those surface features that have sufficient terrain elevation to project into the clearance plane and antenna beam appear on the radar scope. Range scales of 13 or 40 nautical miles may be selected. Refer to figure 1-37 for effective range. A fail-safe cursor and horizon line are provided. Terrain avoidance enables the pilot to avoid collision with obstacles such as hills and mountains during low-level flight. When letting down over terrain for the purpose of landing or contour flying the pilot uses the terrain-avoidance mode as follows: First, set the clearance plane, 6000 feet down; this positions the fail-safe cursor out to 6.8 miles. Information (targets) appearing on the indicator at ranges greater than the fail-safe cursor is reliable. Absence of radar returns at ranges greater than the fail-safe cursor is normal but could indicate a failure of circuits. To further check the reliability of the terrain-avoidance mode, change momentarily to the ground-map mode, and check for additional radar returns.

Note

If the angle of attack vane is removed or damaged the terrain-avoidance mode will be unreliable.

Information appearing at ranges less than the fail-safe cursor is not reliable and **MUST NOT BE USED**. Next, decrease the clearance plane to the desired value and, when targets appear on the indicator beyond the fail-safe cursor, track and avoid these targets down to the fail-safe cursor. The pilot can now begin a slow let-down knowing no targets exist below the aircraft in the unreliable area at the clearance set-in. The process of tracking targets down to the cursor and slow let-down is repeated.

WARNING

Use extreme caution when flying in Contour-Map or Terrain-Avoidance with clearance plane settings of less than 1000 feet if visual contact with the ground is not maintained at all times.

- A broken (flashing) fail-safe cursor, or absence of a fail-safe cursor, indicate that a radar malfunction exists. Do not use the terrain-avoidance or contour-map mode under either condition.

Terrain-Avoidance Button. The terrain-avoidance button (figure 1-34) is a two-position pushbutton switch placarded TER AVOID. When depressed, the radar system is placed in the terrain-avoidance mode, as long as the Bomb/Nav switch is in the NAV position.

Clearance Plane Set Switch. Refer to contour-map mode.

Clearance Plane Indicator. Refer to contour-map mode.

Clearance Calibration Knob. Refer to contour-map mode.

Terrain-Avoidance Calibration and Accuracy Check Over Flat Terrain.

The following calibration and accuracy check should be performed prior to a tactical mission to determine the accuracy of the mode, so that the mission can be accomplished satisfactorily. This check should not be used as an absolute check of mode accuracy. Should a precise check of mode accuracy be required, refer to Terrain-Avoidance System Precision Accuracy Check.

Note

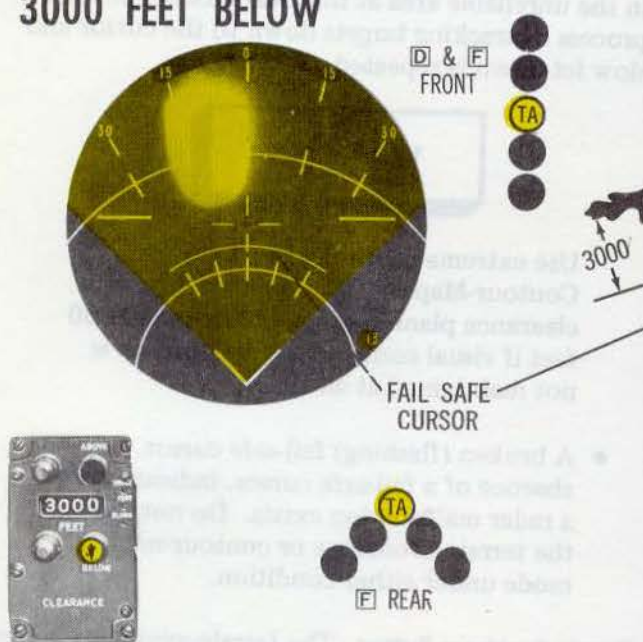
This test shall be made over terrain of known elevation.

TERRAIN AVOIDANCE **mode**

CLEARANCE PLANE PARALLEL
TO AIRCRAFT FLIGHT PATH

NOSE UP ATTITUDE

CLEARANCE PLANE SETTING
3000 FEET BELOW



NOSE DOWN ATTITUDE

CLEARANCE PLANE SETTING
3000 FEET BELOW

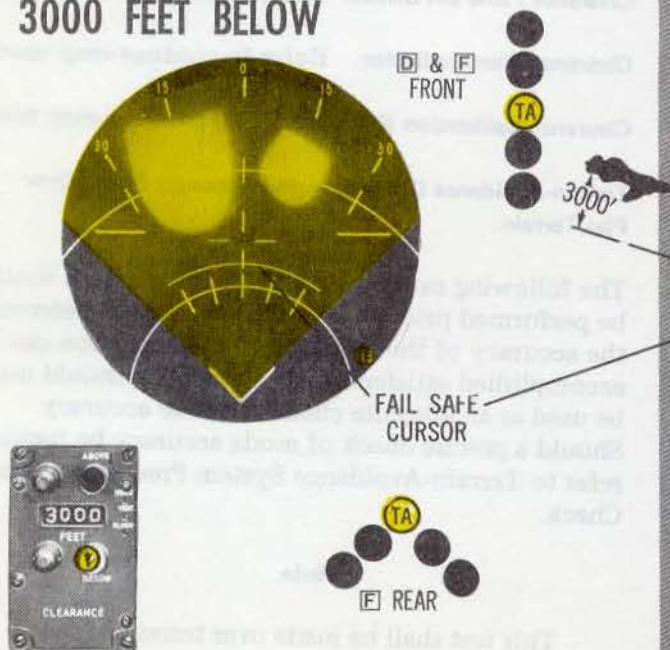


Figure 1-38

Ⓕ • When the crew member in the rear cockpit flies Terrain-Avoidance, a calibration run must be made to set the rear CLEARANCE CALIBRATION control knob. If a run has already been made by the pilot in the front cockpit to set his CLEARANCE CALIBRATION knob, this in no way removes the requirement for the rear pilot to do the same if he is going to fly the Terrain-Avoidance mode.

Ⓕ • Before taking over control of the radar system from the other cockpit the fire control system power switch must be in STBY or ON. If the RADAR take-over button is engaged before the fire control system power switch is in STBY or ON the radar system will switch off and a five minute time delay is required before the radar system will function.

1. Set controls as follows:

a. Fire control system power switch — ON.

Ⓕ b. Depress RADAR control transfer (take-over) button.

Ⓕ c. Depress FLIGHT control transfer (take-over) button.

d. Radar mode button — TER AVOID.

e. Clearance plane set switch — As directed.

f. Bomb-Nav switch — NAV.

g. Intensity knob — Fully clockwise.

h. Memory knob — Set for approximately $\frac{3}{4}$ -second. Do not exceed one second.

Check when the range sweep reaches the right side. At $\frac{3}{4}$ -second, the painted area still visible shall fade out at the center. At one second, the painted area still visible shall fade out near the left hand 15° mark on the bezel.

i. Clearance calibration knob — Set.

Do not change clearance calibration knob setting after calibration as any change may affect calibration accuracy.

j. Video pedestal knob — Set.

Turn knob clockwise until scope just smears, then turn counterclockwise until smearing just disappears. After calibration the video pedestal knob should not need adjustment. Should adjustment be needed, the entire calibration check will have to be repeated.

k. Range scale button — 40 miles.

l. Altitude set knob — fully counterclockwise.

2. Determine tilt (if any) of clearance plane as follows:

a. After take-off, level off at an altitude of 1000 to 2000 feet above the flat terrain.

Note

Lower altitudes can be used at this time; however, lower altitudes will make it more difficult to determine any clearance plane tilt.

b. Leave calibration control at its ground setting.

Ⓕ c. Check to see that FLIGHT control transfer (take-over) button is engaged.

d. Engage autopilot button and altitude-hold switch.

e. Gradually increase clearance plane setting until terrain starts to paint on scope. If instantaneous painting of entire scope takes place, proceed directly to step 4 of this procedure. If only partial painting takes place perform following procedure in steps f through h and all of step 3.

f. Increase clearance plane setting and note where radar return first appears and in which direction it fills the scope.

g. If first appearance is at the top of the scope and fills the scope downward as setting is increased, the clearance plane is tilted down.

h. If first appearance is at the apex and fills the scope upward as setting is increased, the clearance plane is tilted up.

3. Adjust clearance calibration control as follows:

Note

Adjustment for a flat clearance plane in the steps below can affect clearance calibration. Refer to step 4h of this procedure.

- a. Set in a clearance plane setting equal to the known height above the terrain. This is a parameter determined by mission requirements, charts and weather checks.
- b. If clearance plane had a down-tilt (step 2g), turn clearance calibration control clockwise until only a very slight paint remains on the radar scope at approximately 30 miles.
- c. If clearance plane has an up-tilt (step 2h) turn clearance calibration control counter-clockwise until either the outward video movement stops or the limit of the 40 mile range is reached.

Note

At no time should there be any movement of the radar return out of the scope apex.

- d. For either adjustment (up to down tilt), gradually lower clearance plane setting until an almost instantaneous painting of the entire scope takes place. This instantaneous painting proves the clearance plane leveling.
 - e. If instantaneous painting is not obtained, readjust clearance calibration in small increments as necessary to obtain instantaneous painting as outlined in step d.
4. Check accuracy of clearance plane setting as follows:

Note

If mission is to be flown at speeds in excess of 500 KCAS, the specific mission speed shall be used during this check procedure.

- a. Interrupt AFCS altitude-hold by using stick pressure and fly aircraft to height of minimum clearance plane to be used during mission. Release pressure on control stick and

the AFCS will resume altitude hold on the new reference altitude.

- b. Set clearance plane to a value greater than known height above terrain. Scope should have complete painting.
- c. Slowly raise clearance plane until painting on the scope just disappears.
- d. Recheck point of appearance and disappearance of painting by slowly alternating raising and lowering clearance plane.
- e. With no painting on scope, very slowly lower clearance plane until a definite ground return is obtained.

Note

Hard targets in area should not be used to determine this setting.

- f. Record setting of clearance plane indicator.
- g. Recorded value should agree or be less than the known height over ground to assure safe terrain-avoidance indications.
- h. Reading greater than the known height over ground must be compensated for when flying aircraft in terrain-avoidance.

WARNING

Calibration over flat terrain may result in errors on the unsafe side for corresponding calibration over mountains. If mission is to be performed over mountainous terrain, and mountain calibration is not feasible, compensation must be made to assure safe-terrain-avoidance. Unsafe errors, have been noted during test program on terrain-avoidance as given in the Terrain Avoidance Allowable Variation in Clearance Plane Setting Table.

- i. Pull up approximately 5 to 10 degrees and note scope presentation. In terrain-avoidance mode radar returns will not disappear until aircraft flight pitch changes. In contour-map mode there shall be no immediate change until altitude changes.

Terrain-Avoidance Calibration and Accuracy Check Over Isolated Mountains.

The following calibration and accuracy check should be performed prior to a tactical mission to determine the accuracy of the mode so that the mission can be accomplished satisfactorily. This check should not be used as an absolute check of mode accuracy. If a precise check of the mode accuracy is required, refer to Terrain-Avoidance System Precision Accuracy check.

Note

- Ⓔ When the crew member in the rear cockpit flies terrain-avoidance, a calibration run must be made to set the rear CLEARANCE CALIBRATION knob. The rear pilot must have the fire control system power switch in ON or STBY prior to taking over the RADAR control otherwise radar information will be lost and approximately 5 minutes will be required before the radar system will recycle again.

If a run has already been made by the pilot in the front cockpit to set his CLEARANCE CALIBRATION knob, this in no way removes the requirement for the rear pilot to do the same if he is going to fly the terrain-avoidance mode.

1. Set controls as follows:

- a. Fire control system power switch — ON.
- Ⓔ b. FLIGHT and RADAR control transfer (take-over) buttons — Engage.
- c. Radar mode button — TER AVOID.
- d. Clearance plane set switch — For minimum planned setting for mission.
- e. Bomb-Nav switch — NAV.
- f. Range scale button — 40 miles.
- g. Intensity knob — Fully clockwise.
- h. Memory knob — Set for approximately $\frac{3}{4}$ -second. Do not exceed one second.

Check when the range sweep reaches the right side. At $\frac{3}{4}$ -second, the painted area still visible shall fade out at the center. At

one second, the painted area still visible shall fade out near the left hand 15° mark on the bezel.

i. Clearance calibration knob — Set.

Do not change clearance calibration knob setting after calibration as any change may affect calibration accuracy.

j. Video pedestal knob — Set.

Turn video pedestal knob clockwise until the scope smears then turn counterclockwise until smearing just disappears. After calibration the video pedestal knob should not need adjustment. Should adjustment be needed, the entire calibration check will have to be repeated.

k. Altitude set knob — Fully counterclockwise.

2. Fly by the reference point (isolated mountain) and note its altitude on the pressure altitude scale.
3. Fly outbound at least 20 miles and climb to a pressure altitude noted in step 2 plus the clearance plane set in step 1. Record this reading.
4. Turn back on the reference point and perform the calibration and accuracy test as follows:

Note

If mission is to be flown at speed in excess of 500 KCAS, the specific mission speed shall be used during this calibration procedure.

- a. Stabilize altitude at the pressure altitude of step 3. Engage autopilot and altitude-hold switches.
- b. Adjust clearance calibration knob on right console until the reference point just appears on the scope. This must be done prior to reaching 10-mile mark.
- c. When target reaches 13 miles, switch to the 13-mile range.
- d. Track target to 10 miles, adjusting clearance calibration knob so that reference point image just appears on scope.

Note

No further adjustment of clearance calibration knob should be required.

- e. Track target into fail-safe cursor. During tracking, continuously monitor the reference point image to see that it remains the same size. If it changes, clearance calibrating knob setting is not correct. Turn outbound and repeat the procedure from start or step 4.
- f. Record the clearance plane setting at the point at which the image intersects the fail-safe cursor. Calibration run may be terminated at this time.
- g. The clearance plane setting of step f shall agree with, or be less than, the clearance plane setting of step 1c, to assure safe terrain-avoidance operation.
- h. If the clearance plane setting of step f is greater than the clearance plane setting of step 1d, the readings must be compensated for when using terrain-avoidance mode.

WARNING

Data obtained during the terrain-avoidance test program indicates a maximum difference of 300 feet in clearance plane indications between flat and mountainous terrain, as follows:

- If clearance plane is calibrated over level terrain, the clearance plane will be accurate over level terrain, and up to 300 feet inaccurate in mountainous terrain.
 - If the clearance plane is calibrated on a mountain peak, the clearance plane will be accurate in mountainous terrain and up to 300 feet safe over level terrain.
- i. Pull up approximately 5 to 10 degrees and note scope presentation. In terrain-avoidance mode radar returns will not disappear until aircraft flight path starts to change. In contour-map mode there shall be no immediate change until altitude changes.

Terrain-Avoidance System Precision Accuracy Check.

After the terrain-avoidance calibration and accuracy check has been completed, precise system accuracy can be checked by performing the following:

1. Fly outbound at least 35 miles from obstruction and using the altitude scale of the AVVI climb to an altitude above the obstacle noted on the table below. Turn inbound and perform a data run, recording clearance plane settings at the specific points.
2. Adjust clearance plane indicator setting until the obstacle just appears on the scope at 10, 6, and 3 miles.

Satisfactory performance is indicated when readings are within limits in table below. Although the mode accuracy may exceed the allowable variation, a mission can still be accomplished by compensating for the error.

TERRAIN AVOIDANCE ALLOWABLE VARIATION IN CLEARANCE PLANE SETTING

Height Above Obstacle in Feet	Range in Miles			
	25	10	*5	*3
500		0 to 1000 feet	150 to 850 feet	150 to 850 feet
1000		300 to 1700 feet	600 to 1400 feet	600 to 1400 feet
2000	300 to 3700 feet	1300 to 2700 feet	1500 to 2500 feet	

**If fail-safe cursor exceeds this range, take readings just prior to the fail safe cursor. Do NOT take readings inside the fail safe cursor.*

Radar Preflight Check -- R-14.**Note**

- ☐ The following checks are accomplished in each cockpit for dual flights and in the front cockpit for solo flights.

[F] When flying dual, before taking over control of the radar system for the ground check, the fire control system power switch must be at STBY or ON before depressing the RADAR take-over button. If this is not done, the normal five minute radar warm up time will be required before the check can commence.

1. Memory knob — Fully counterclockwise.
2. Fire control power switch — ON (5 minute warm up).
- [F] 3. RADAR take-over button — Press in cockpit performing check.
4. Radar mode button — GRD MAP (PENCIL).
5. Bomb-Nav switch — NAV.
6. Antenna tilt wheel — Run full up and down. Position antenna at zero tilt.
7. Range scale button — 13 mile scale range.
8. Radar indicator — Check by moving the following controls through their maximum ranges:
 - a. Receiver Gain.
 - b. Video Pedestal.
 - c. Memory.
 - d. Intensity.
 - e. Bezel Brilliance.
 - f. Altitude Set.
 - g. Cursor Brilliance
 - h. Clearance Calibration.
9. Optimize radar displays as follows:
 - a. Intensity — Full clockwise.
 - b. Receiver gain — Full aft (OFF).
 - c. Video pedestal — Full counterclockwise.
 - d. Memory — As required.

- e. Adjust bezel brilliance to desired amount.
- f. Altitude set full counterclockwise.
- g. Cursor brilliance knob — Full counterclockwise then fully clockwise. Turn knob counterclockwise to optimize the azimuth cursor and horizon lines. Check horizon lines are horizontally centered and azimuth cursor extends from the scope apex to the top of the range sweep.
- h. Video pedestal knob — Rotate clockwise until scope starts to smear then backoff counterclockwise until semaring just disappears. After optimizing in the 80 mile range, select 40 and 13 mile range scales and observe that the video pedestals do not require adjustments when range scales are changed.
- i. Adjust memory as desired.
- j. Increase receiver gain (forward motion) until targets appear.
- k. Depress range cursor button to obtain 30,000, 40,000 or 60,000 foot range cursors.
- l. Select TA — Check fail-safe indicator. Run clearance plane from 0000 to 6000 feet and back.
- m. Bomb/Nav switch — BOMB, Check automatic changeover from TA to CM and presence of range cursors.
- n. Bomb/Nav switch — NAV.

Bomb-Bay Station Selector Button. The bomb-bay station selector button (figure 1-3) is a guarded two-position pushbutton marked BB, and is used to select the internal store station, and to open and close the bomb bay doors for manual operation. In the [F] this button is operative in the cockpit which has the WEAP-ONS control transfer (take-over) button engaged. If the fire-control system is set up for an automatic bomb release, the bomb-bay doors will open only after the bomb-bay station selector and the freeze/fire buttons is depressed. If installed, a fuel tank and pylon carried on the fuselage centerline station will automatically be jettisoned when the bomb-bay doors open. The internal store will be released automatically when the TBC supplies a release signal, and the bomb-bay doors will close automatically after the store is released. For manual release of the internal store, the bomb-mode selector knob must be in

the MAN position, the bomb-bay station selector button (the guard must be unlocked) depressed to open the bomb-bay doors and, simultaneously, arm the internal store release circuit. Depressing the freeze/fire button releases the store and the bomb-bay doors close automatically. When the bomb-bay station selector button is pulled out, the internal store release circuit is disarmed (de-energized). The bomb-bay station selector button is powered by DC primary power.

Note

- Ⓔ The circuit is interlocked so that once the doors are opened by either crew member, that same crew member must continue to release the weapon for automatic door closing or disengage the BB station selector button for manual closing. Once the doors are preset to open or were opened by a crew member, they must be closed by that same crew member. This interlock function overrides the WEAPONS take-over function.

Bomb-Bay Door Auxiliary Handle. In the event of electrical failure, the bomb-bay door auxiliary handle (figure 1-7) (not in rear cockpit) located above the forward right-hand console mechanically actuates the bomb-bay door control valve. The handle which is marked BOMB BAY DOOR AUX has three positions: OPEN, OFF, and CLOSED, and is guarded in the OFF position. The guards must be lifted before the handle can be positioned to OPEN or CLOSED. When the handle is placed in the OPEN position, the control valve is mechanically positioned to permit utility and bomb-bay door accumulator hydraulic pressure to open the doors. Placing the handle in the CLOSED position closes the doors.

Note

The bomb-bay door auxiliary handle overrides the BB station selector button.

Displacing Gear Pressure Indicator. A displacing gear pressure indicator (figure 1-7) is provided to indicate the air pressure available to unlock and extend the displacing gear cylinder. The indicator is powered by DC secondary power. See figure 5-1 for pressure limits.

Bomb-Bay Door Open Indicator Light. The bomb-bay door open indicator light (figure 1-60) located on

the caution panel displays BOMB-BAY DOOR and is powered by DC primary power. It will illuminate when the doors are unlocked and remain illuminated until the bomb-bay doors are fully closed and locked at which time the light will go out.

X-BAND RADAR BEACON.

The X-band radar beacon will allow the pilot to detect, identify and deliver weapons to a designated area or to identify airborne tankers for inflight refueling. The beacon utilizes the ground map modes of the R14 radar system and is controlled by a radar/beacon switch on the radar control panel. All radar system modes of operation are retained. With the radar in ground map mode and the beacon operating, the pilot can identify and orient his flight path to a beacon transponder. The location of the beacon will be indicated as a pip in the radar scope. Azimuth markers, range markers, range scale lights and horizon bars will be retained; however, the terrain indication for ground map mode will be eliminated. If the beacon is the target, a normal IP or TIP weapons delivery can be accomplished. Under conditions where the beacon cannot be located at the target, a requirement is imposed to situate the beacon at a predetermined position in relation to the target so that a BIP bombing mission can be accomplished. Similarly, a tanker can be located for inflight refueling by using the tanker's beacon.

Radar/Beacon Switch.

The radar/beacon switch, located on the radar control panel, is a two-position switch placarded RADAR and BEACON. When in the RADAR position all radar modes operate normally. In the BEACON position, with the radar in GRD MAP SPOIL or PENCIL, beacon position is indicated on the radar scope as a pip. Ground terrain indications are eliminated.

Radar Beacon Operation.

To acquire the radar beacon mode, set the following controls:

1. Fire control system power switch — ON.
- Ⓔ 2. RADAR control transfer (take-over) button — Depress in cockpit with control.
3. GRD MAP radar mode switch — SPOIL or PENCIL.
4. Radar/beacon switch — BEACON.

Note

- Ⓔ The cockpit with radar control can switch to beacon mode or return to radar mode by positioning the radar/beacon switch to BEACON or RADAR respectively, provided the radar/beacon switch in the cockpit without radar control is in the RADAR position. If either forward or aft radar/beacon switch is in BEACON, beacon mode will be acquired if GRD MAP SPOIL or PENCIL is selected in the cockpit with radar control.

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT.

Note

See Communications and Associated Electronic Equipment Table (figure 1-39) for a summary of the equipment in the aircraft.

The communication, identification, and navigation (CIN) systems which provide air-to-air and air-to-ground communication, aircraft identification, and navigation equipment for guidance during flight, are integrated to form a CIN subsystem that employs a central power supply which is composed of a primary, secondary, and an emergency power section, each of which furnishes power to one or more of the foregoing systems (see figure 1-40). The integrated power supply is powered from three phase AC secondary power, DC primary power, and DC secondary power, and supplies power to the command radio, AN/ARA-48 automatic direction finder group, Tactical Air Navigation System (TACAN), Instrument Landing System (ILS), and Identification Friend or Foe (IFF/SIF) system. If there is a DC primary power failure, the entire CIN system is inoperative. The AN/ARC-70 command radio has priority over the other equipment using the power supply. If any DC powered modules in the CIN power supply, which supply power to the command radio fail, automatic switching within the power supply takes place to use the AC powered CIN modules (emergency back-up) to maintain operation of the AN/ARC-70 command radio. This switching will also occur if any of the AN/ARC-70 radio set voltages drop below a preset value which is necessary for normal operation. Failures of this kind will illuminate a caution light together with the master caution light. The navigation indicators of the integrated instrument system display information

from the ILS, TACAN, ADF, and DOPPLER systems. An instrument-selector switch is incorporated to provide selection of the system information to be displayed on the indicators. The AN/APN-131 navigation system is not integrated and has separate power supply and functions. Antennas are concealed within the aircraft to protect them from dirt and airloads during high speed flight and to maintain an aerodynamically clean aircraft.

In the Ⓔ all sets except IFF/SIF (AN/APX-37) are remotely controlled from either cockpit with visual indicators on the consoles and instrument panels. Controls for the IFF/SIF set are not in the rear cockpit. Before control of a system can be accomplished by either pilot, the control transfer system (take-over) button in the cockpit assuming control of the particular system must be engaged. The control transfer buttons are in the front and rear cockpit and permit transfer of a system control between cockpits. The control transfer (take-over) system is described in section I and the specific take-over button is described under its appropriate paragraph.

ANTENNA LOCATION.

For antenna location see figure 1-41.

CIN MAIN POWER SUPPLY CAUTION LIGHT.

The CIN power supply caution light (figure 1-60) located on the caution light panel displays CIN PWR when illuminated and is powered by the DC primary bus. Conditions that will cause this light to illuminate and the systems that are operative or inoperative when the light is illuminated are as follows:

<i>Condition Causing Light Illumination</i>	<i>Equipment Operating</i>	<i>Equipment Inoperative</i>
DC voltage drop of 12-30% to command radio module, or DC POWER SECTION OF CIN POWER SUPPLY FAILS	COMMAND RADIO (in back-up, using power normally supplied to TACAN), ILS, ADF, and IFF/SIF.	TACAN
AC secondary power failure—AC GEN failure and AC GEN OUT light illuminated. DC secondary power failure. DC GEN failure and DC GEN OUT light illuminated.	COMMAND RADIO, IFF/SIF.	ILS TACAN ADF

COMMUNICATIONS

AND

**associated
electronic
equipment**

TYPE	DESIGNATION	FUNCTION	RANGE	CONTROL LOCATION
INTER-COMMUNICATION SET	AN/AIC-20	Voice communication between front and rear cockpits, and either crew member and ground crew. Connects audio of the radio, navigation, missile, and landing gear audio warning signal to both crewmembers head sets.	Between cockpits, and cockpits and ground crew.	Left console both cockpits.
UHF COMMAND RADIO	AN/ARC-70	AM radio communication between aircraft and ground radio stations, and between aircraft.	Line of sight up to 250 miles air to ground, and up to 550 miles air to air.	Left console both cockpits.
☒ RADIO RELAY POD [D-686] C/W		AM radio communication between two radio stations	Same as UHF command radio	Right console
DIRECTION FINDER GROUP	AN/ARA-48	Provides signals to the HSI on the main instrument panels which indicate magnetic bearing to a UHF radio signal source.	Same as UHF command radio.	Uses command radio control panel.
LOCALIZER, GLIDE SLOPE, & MARKER BEACON RECEIVER (ILS)	AN/ARN-61	Receives ILS radio signals & provides visual indications on the ADI & HSI for vertical & lateral guidance, and receives marker beacon signal to indicate position.	Localizer-approx. 45 miles. Glide slope approximately 25 miles.	Right console both cockpits.
UHF NAVIGATION RADIO (TACAN)	AN/ARN-62	Used in conjunction with TACAN to provide bearing and distance information to a TACAN station. Visual display on the HSI.	Distance measuring up to 200 nautical miles. Bearing information, line of sight.	Right console both cockpits.
DOPPLER NAVIGATION SYSTEM	AN/APN-131	Self-contained microwave radar transmitter-receiver and computer which solves navigation problems. Visually displays present position, ground speed drift angle, and course to fly to either of two destinations on the ADI and HSI.	Transmitter-Receiver: 0 to 70,000 feet altitude, 147 to 1500 knots. Computer: 2,000 nautical miles each destination.	Right console both cockpits.
IDENTIFICATION RADAR (IFF/SIF)	AN/APX-37	Receives coded interrogation from a ground station and automatically transmits predetermined coded reply.	0 to 150 miles line of sight.	Right console front cockpit.

Figure 1-39

CIN CENTRAL POWER SUPPLY

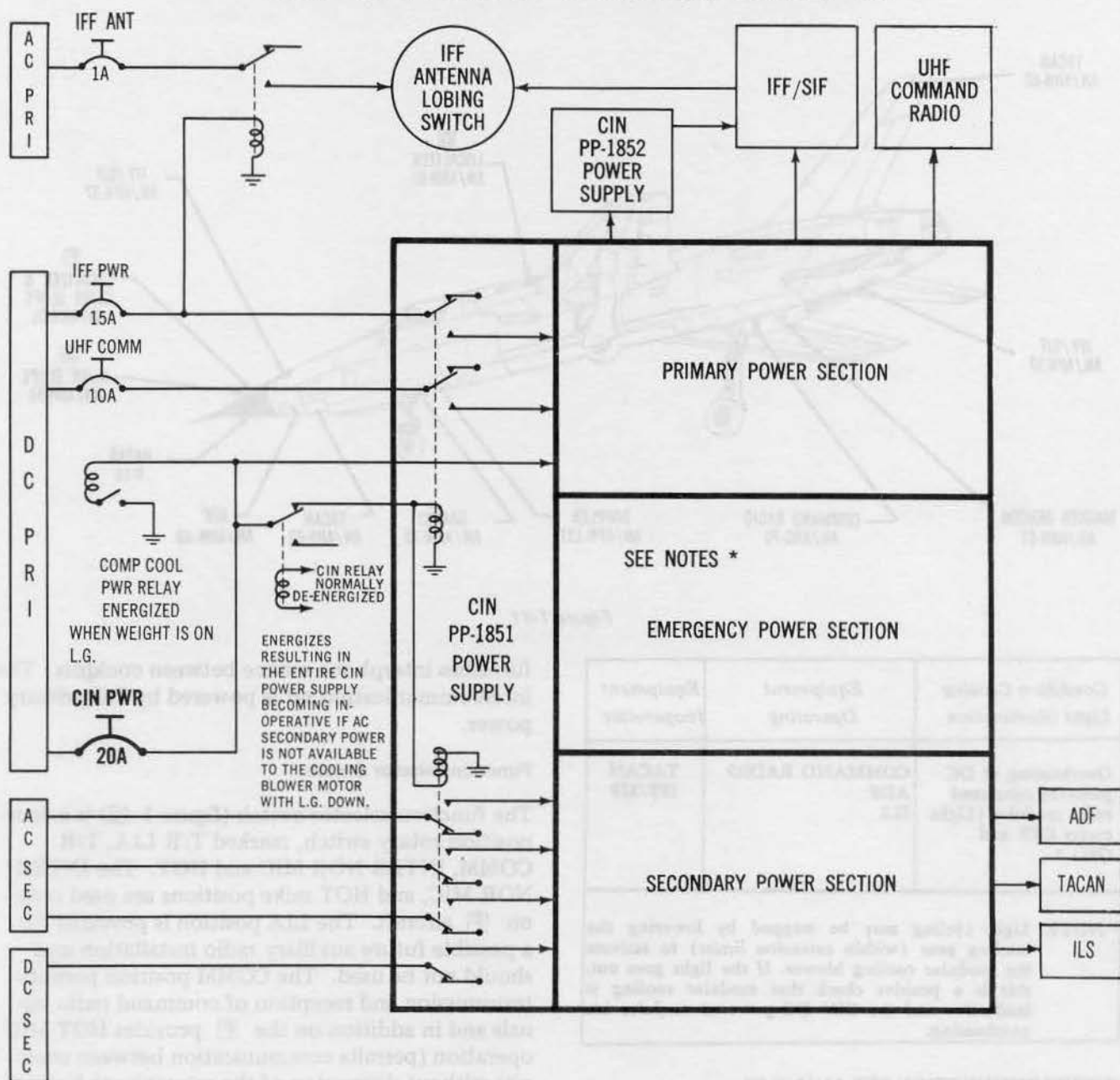


Figure 1-40

ANTENNA LOCATIONS

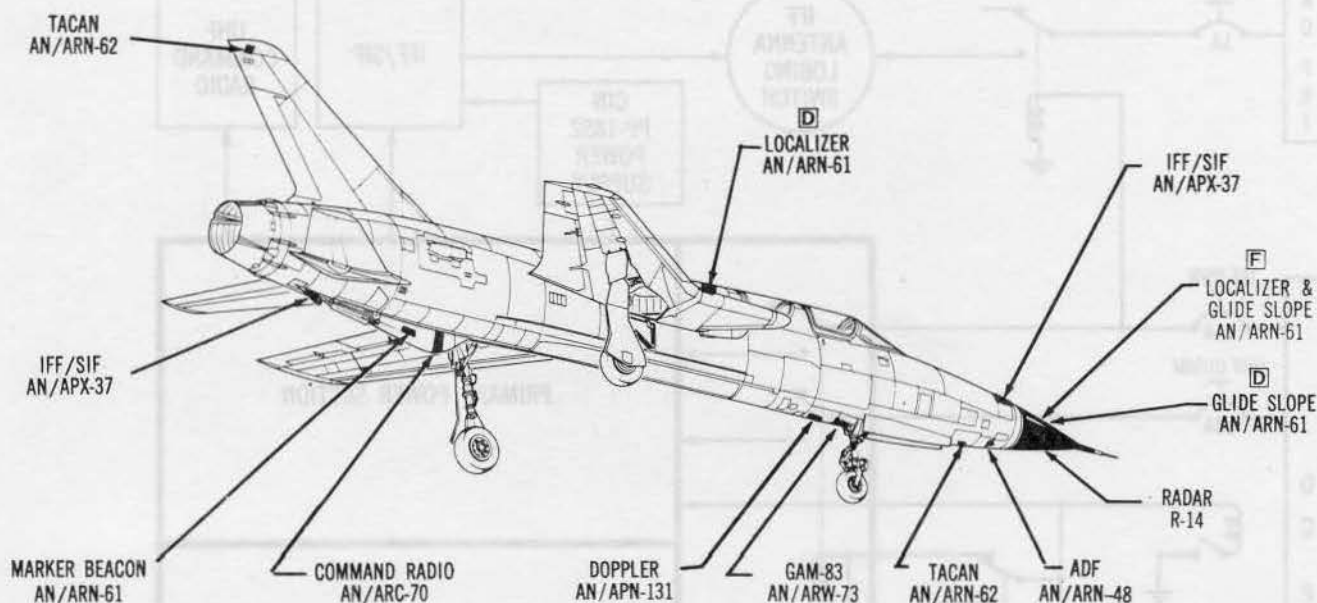


Figure 1-41

Condition Causing Light Illumination	Equipment Operating	Equipment Inoperative
Overheating of DC powered command radio modules (Light cycles OFF and ON).*	COMMAND RADIO ADF ILS	TACAN IFF/SIF
* NOTE: Light cycling may be stopped by lowering the landing gear (within extension limits) to activate the modular cooling blower. If the light goes out, this is a positive check that modular cooling is ineffective and the CIN DC powered modules are overheating.		

INTERCOMMUNION SET-AN/AIC-20.

The AN/AIC-20 intercommunion set, (figure 1-42) is provided so that AIC headset type H-79, AIC microphone type M-55 or their equivalents can be used. The set is basically an amplifier, connected electrically to the command radio, TACAN, ILS, missile audio system, and the landing gear audible warning system. The intercom set amplifies radio signals transmitted and received and is controlled by a panel in the cockpit. In addition, it furnishes interphone service between the ground crew or maintenance personnel through a plug-in connector when the aircraft is on the ground and in the [F], it

furnishes interphone service between cockpits. The intercommunication set is powered by DC primary power.

Function-Selector Switch.

The function-selector switch (figure 1-42) is a four-position rotary switch, marked T/R LIA, T/R COMM, INTER NOR MIC and HOT. The INTER NOR MIC, and HOT mike positions are used only on [F] aircraft. The LIA position is provided for a possible future auxiliary radio installation and should not be used. The COMM position permits transmission and reception of command radio signals and in addition on the [F] provides HOT MIC operation (permits communication between cockpits without depression of the microphone button). In the [F], control of the command radio is determined by the depression of the COMM transfer control take-over button in either cockpit. The NOR MIC position permits communication between the front and rear cockpit using the microphone button on either throttle. The HOT position permits communication between the front and rear cockpit without depressing the microphone button on either throttle grip. Depressing the microphone button when at HOT mike will not result in transmission outside the aircraft. In addition, audio signals from the TACAN, ILS and missile equipment are monitored, simultaneously.

INTERCOM

AN/AIC-20

control panels



Figure 1-42

Intercom aux/normal switch.

The intercom aux/normal switch (figure 1-42), which has two positions marked NOR and AUX, is normally left in the NOR position for monitoring of radio, navigation, and missile audio in addition to command set audio and in addition on the [F] for interphone operation between cockpits. The AUX position is selected only if the AN/AIC-20 (headset) amplifier fails to receive. With the switch in this position, the audio output of the command set is connected directly to the headset. All other radios are disconnected. The switch is safetied in the NOR position with soft safety wire.

Volume Control Knob.

The volume control knob (figure 1-42), marked VOL, is used for adjusting the volume of the interphone set between the cockpit and maintenance interphone stations. On the [F] the knob is also used for adjusting volume of the interphone between cockpits. The crew member in each cockpit controls his own volume. The audio volume of each radio navigational set or missile audio must be adjusted on its individual control panel for the desired audio level.

Call Switch.

The call switch is a two-position spring-loaded switch placarded CALL. This switch is inoperative on the [D], and on the [F] is used to call the other crew member regardless of switch positions or volume control setting on the intercom control panel. When the switch is held in the CALL position, it overrides the microphone button and transmission outside the aircraft will not occur however, other signals will be mixed and monitored at a reduced level.

Operation of the Intercom Set.

In the [F] operation of the intercom set is controlled by each pilot as required and is independent of the take-over system.

Command Radio Operation.

1. Function selector switch — COMM.
2. Intercom aux/normal switch — NOR.
3. Press microphone button on the throttle grip to transmit.

4. Release microphone button when transmission is completed to permit receiving reply.

Note

- [F] During all modes of intercommunication operation signals from all operating radio and navigation equipment will be mixed and simultaneously heard by each crew member.

[F] **Interphone Operation.**

1. Function selector switch — COMM.
2. Intercom aux/normal switch — NOR.
3. Crew members can communicate without depressing the microphone button. If the microphone button is depressed, with the command radio ON, transmission outside the aircraft will occur.

[F] **Selective Interphone Operation Only.**

1. Rotate function-selector switch to NOR MIC.
2. Press microphone button on throttle and talk.

Note

- [F] If the mike button is held depressed transmission outside the aircraft will not occur. The microphone button must be released to allow the other crew member to reply.

[F] **Continuous Interphone Operation.**

1. Rotate function-selector switch to HOT and talk.

Note

- [F] It is not necessary to depress the microphone button before talking. The other crew man can listen and talk regardless of the function selector switch position on his intercom control panel.

[F] **Interphone Call Operation.**

1. Hold the call switch at CALL to talk to the other crew member.

Note

- [F] The other crew member will receive the message regardless of the position of his function-selector switch.
- Whenever the call switch is held at CALL, it overrides the microphone button. Transmission outside the aircraft will not occur when the call switch is activated.

Intercom Amplifier Failure.

1. Intercom aux/normal switch — AUX.

All other radios are disconnected. Command radio signals bypass the intercom set and are connected directly to the headset.

Intercom Operation with Ground Crew.

1. Intercom aux/normal switch — NOR.
2. Function selector switch — COMM.

This will provide a "hot mike" connection for ground crew interphone when the volume control is advanced sufficiently. If the pilot depresses the mike button ground crew conversation will be broadcast if the AN/ARC-70 radio is turned on.

MISSILE AUDIO CONTROL.

T.O. 1F-105F-559 installed a missile audio volume control in the rear cockpit of the F-105F/G aircraft which functions independently of the control in the forward cockpit. (Figure 1-6, Sheet 2 of 2).

The volume control of the AIC-20 will affect the missile volume but the missile volume control has no effect on the AIC-20 volume. The volume control for the AIC-20 should be adjusted for the desired level for inter-crew operation and the individual missile audio control can then be adjusted independently.

COMMAND RADIO-AN/ARC-70.

The AN/ARC-70 command radio set provides voice transmission and reception on 1750 frequencies. Frequency selection can be made in steps of 0.1 megacycle within the range of 225.0 to 399.9 megacycles. The control panel (figure 1-43) is on the

left console. Selection of any of 20 frequencies can be preset in any order. In addition an operating frequency can be set up manually without disturbing any of the preset frequencies. The set uses two receivers: main, and guard. The guard receiver is capable of covering the frequency range of 238.0 to 248.0 megacycles; however, it is fixed prior to

installation to 243.0 megacycles. The functions of the set are selected by the four-position function switch on the control panel. A mode selector switch on the control panel provides for rapid selection of the guard, preset, or manual modes of operation. A tone pushbutton on the control panel is provided for continuous tone transmission to aid ground

stations in obtaining a directional fix. A preset channel selector knob on the control panel is used to select any of the 20 preset frequencies. The channel selected is displayed in the channel windows of the control panel and the windows of the remote frequency channel indicator. The manual frequency selector knobs permit manual selection of a frequency within the operating range of the set. The selected frequency is displayed in the manual frequency windows and the remote frequency channel indicator. A numerical indication of the selected channel appears in a window adjacent to the preset channel selector knob, and in the window of the remote frequency channel indicator on the main instrument panel. Audio volume is adjusted by a knob on the control panel. The radio will operate if the main power supply is functioning and the AC secondary and DC primary busses are energized. The radio is normally powered by the DC primary modules of the CIN power supply. If voltage to the command radio falls below normal, or certain DC powered modules fail, the command radio will be operated by an AC powered back-up module. When this occurs, the CIN PWR caution light will illuminate indicating the IFF and TACAN sets may be inoperative. The command set is then in back-up or auxiliary operation and is dependent on AC secondary power for operation. In the **[E]** the pilot in either cockpit can assume control of the command radio by depressing the COMM take-over button on the transfer panel in his cockpit. The COMM take-over button in the cockpit which does not have control, will illuminate and display NO CONTROL. The control panel operates only in the cockpit with control of the COMM system.

Communication Control Transfer (Take-Over) Buttons. **[E]**

The communication control transfer (take-over) button (figure 1-60) permits transfer of command radio control between cockpits. The buttons are solenoid-held pushbutton switches placarded COMM, and pressing this button in either cockpit transfers control of the command radio to that cockpit. The COMM button in each cockpit contains a yellow integral legend type indicator light which illuminates displaying NO CONTROL in the cockpit that does not have control of the command set control panel. When flying solo, the front cockpit has control of the command radio whether the button is depressed or not. When flying dual, either pilot can transmit on the frequency selected by the cockpit in control. The button solenoid is powered by DC primary power and the indicator light is powered by AC primary

power. Refer to section I for details of the control transfer (take-over) system.

Function Switch.

The function switch (figure 1-43) has four positions marked OFF, MAIN, BOTH and ADF. The OFF position places the main and guard receivers in standby. In the MAIN position, the radio receives on the main receiver, and both the main receiver and transmitter are turned to the preset or manually selected channel, while the guard receiver remains inoperative. When the switch is in BOTH position, the radio will receive signals simultaneously from the guard receiver, which is constantly tuned to the guard channel, and from the main receiver. Both the main receiver and the transmitter are turned to either a preset or manually selected frequency. In ADF mode only ADF navigation information will be displayed on the HSI. The ADF position integrates the AN/ARA-48 direction finder group with the frequency selected on the AN/ARC-70 and provides automatic direction finder functions. Bearing information to the station is displayed on the bearing pointer of the HSI. The UHF bearing pointer indicator light on the HSI will illuminate. The auxiliary guard receiver is inoperative in this position.

Preset Channel Selector Knob.

The preset channel selector knob (figure 1-43) is used to select any one of 20 preset frequencies. The channel number selected is indicated in the channel window marked CHAN on the control panel, and in the window of the remote frequency channel indicator on the main instrument panel. Clockwise rotation of the selector increases the number displayed in the windows. The frequency selected will show in the manual frequency-selector indicator window on the control panel, and on the remote-frequency channel indicator on the main instrument panel.

Note

- [E]** The channel number is shown on the control panel of the cockpit with COMM control, and on the remote frequency channel indicator in each cockpit.

Manual Frequency Selector Knobs.

There are three manual frequency-selector knobs (figure 1-43) on the control panel which permit manual selection by the pilot of any of the 1750 frequencies in the radio's tuning range for

COMMAND SET AN/ARC-70

control panel

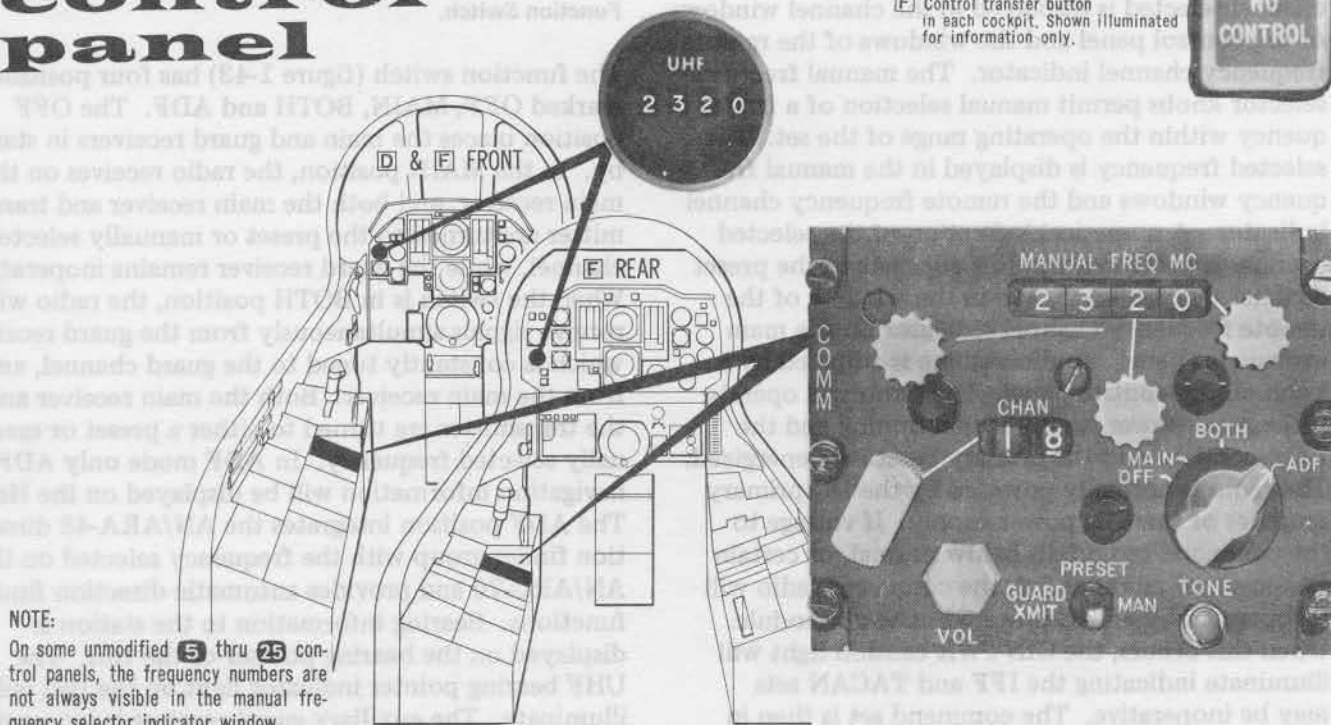


Figure 1-43

transmit-receive operation. A manual frequency-selector indicator window on the control panel, and a remote frequency channel indicator are provided to display megacycles and tenths of a megacycle, of each frequency manually selected.

Note

To transmit and receive on the manually selected frequency, the mode-selector switch must be at MAN.

- [F] The frequency selected is only shown in the manual frequency window on the control panel of the cockpit in control of COMM, and on the remote channel indicator in each cockpit.

Tone Pushbutton.

The spring-loaded pushbutton marked TONE (figure 1-43) switches the radio from receive to tone transmission on the manually selected or preset frequency on which the radio is operating. As long as the pushbutton is depressed, a continuous 1020 cycle tone is transmitted. The pushbutton may be

used as a key for code transmission or for direction finding operations in conjunction with other aircraft and ground stations. The microphone press-to-talk button, regardless of its position, has no effect on the operation or function of the tone pushbutton.

Volume Control.

The volume control (figure 1-43), marked VOL, regulates the headset volume for signals received on both the main and guard receivers. Volume control range is predetermined so that the signal volume may not be reduced below a preset level. Transmitter output power is fixed and cannot be changed by the pilot.

Microphone Button.

The microphone button (figure 1-11) located on the throttle, switches the radio set from receive to transmit operation for voice modulation when held in the depressed position. When the button is released, the radio returns to receive operation.

Mode Selector Switch.

The control panel (figure 1-43) incorporates a mode-selector switch. The switch has three positions; GUARD XMIT, PRESET and MAN and is used to select the preset, guard transmit or manual mode of operation.

Remote Frequency Channel Indicator.

The remote frequency channel indicator (figure 1-43) displays the channel number of any of the 20 preset frequencies selected by the preset channel selector knob, the manual frequency selected, or the letters GD appear when operating in the guard-transmit mode. The displays selected by the cockpit in control will be shown on both indicators.

Normal Operating Procedures.

Note

No transmission will be made on emergency (distress) frequency channels except emergencies. For test demonstration, or drill, the radio equipment will be removed from the aircraft and operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.

- [F] • The mode of operation and frequency or channel selected is controlled by the pilot in control of the COMM functions, however, either pilot can transmit on the selected frequency or channel.
- [F] 1. COMM take-over button in cockpit taking control of the command radio — Depress.
- 2. Place the mode selector switch at PRESET and the function switch in the BOTH position and allow approximately two minutes warmup of main and guard receiver units.
- 3. Rotate the preset channel selector knob until desired number appears in the CHAN window of the control panel and on the remote frequency channel indicator.

Note

When selecting a new preset channel, there will be a delay of four seconds before the automatic tuning cycle adjusts the set for operation on the newly selected frequency.

- 4. Adjust the volume control for desired audio level.
- 5. Before transmission check that the equipment is functioning, and tuneup complete, by listening for voice side tone or tone signal when the tone button is depressed.
- 6. For manual selection of a frequency that is not included in the preset channels, place the mode-selector switch at MAN. The selected frequency is visible in the four windows across the top of the control panel and the windows of the remote frequency channel indicator. Use the three manual tuning knobs to establish desired frequency. The numbers that appear in the windows and the remote frequency channel indicator show operating frequency. The function switch must be at MAIN or BOTH for this operation.
- 7. To obtain transmission and reception of the guard frequency, the function-switch should be at BOTH and the mode-selector switch at GUARD XMIT. The letters GD appear in the remote frequency channel indicator.
- 8. Placing the function switch of the AN/ARC-70 set at OFF puts the set in standby condition. The UHF COMM or CIN PWR (ELEC SYS CNTRL PWR) circuit breakers must be pulled out to turn the set completely off.

Note

Once the radio set has been completely turned off, a 25 to 35 second warm-up period must be completed before radio transmission can be resumed, when the set is again turned on. On aircraft with unmodified power supplies, (below S/N 220) a warm-up period of approximately 75 seconds must be completed. The warm-up periods will be slightly greater when the DC generator is not operating.

Emergency Operating Procedures.

In case of apparent failure of equipment, attempt operation in alternate positions of the mode-selector switch (GUARD XMIT, PRESET or MAN) and/or alternate positions of the function switch. Turn equipment off for several minutes, then turn function switch to type of operation desired. If the tuning mechanism was responsible, this action will restore operation. Check circuit breaker panel for tripped condition of the INTERCOM circuit breaker.

If intercom set amplifier is out, place intercom aux/normal switch on intercom control panel in the AUX position to bypass the intercom amplifier and direct command radio audio signals directly to the headset. (Only COMMAND radio reception is possible.)

RADIO RELAY SYSTEM [D-686] C/W.

The radio relay system provides a communication relay between two radio stations operating in the UHF band, 225.00 to 399.95 Mc. As a secondary function, the system may be used by the pilot as a back-up communication system in lieu of his ARC-70 command radio. The relay system consists of a radio relay pod carried on the centerline pylon, a control head and a control panel both mounted on the right hand console. The pod contains two ARC-51BX receiver-transmitter units which are utilized to receive and retransmit signals simultaneously provided each unit is tuned to a different frequency. When a signal is being received from one of the ground stations, the corresponding receiver energizes the transmitter of the other R/T unit.

The pilot can monitor the relay in his headset. The control panel selects power to energize each R/T in the pod and also controls which radio will be tuned to the frequency selected on the control head. The system is powered by DC secondary power.

Control Panel.

Power Switch. The power switch is placarded POWER CONT and has four positions: OFF, UHF1, UHF 2 and RETRAN. The OFF position removes power from the radio relay system. The UHF 1 and UHF 2 positions energize the respective radios in the pod. The RETRAN position energizes both radios and the system functions as a communication relay.

Tune Select Switch. The tune select switch is placarded TUNE SELECT and has two positions: UHF 1 and UHF 2. The UHF 1 and UHF 2 positions tune radios 1 and 2 respectively to the frequency selected on the control head.

Note

While the radios are being programmed to the frequency selected on the control head, an 800 cycle tone is heard in the pilot's headset.

Pod Normal Switch. This switch has two positions placarded; POD and NORMAL. This switch is not used.

Control Head.

Function Selector Switch. The function selector switch has four positions placarded; OFF, T/R, T/R + G and ADF. This switch is not used.

Mode Selector Switch. The mode selector switch has three positions placarded; PRESET CHAN, MAN and GD XMIT. The PRESET CHAN position permits selection of one of 20 preset channels by means of the preset channel selector. The MAN position permits manual selection of frequency by use of the manual frequency selectors. The GD XMIT position is not used.

Preset Channel Selector. The preset channel selector permits the selection of any of the 20 preset channels.

Manual Frequency Selectors. The three manual frequency selector knobs provide selection of frequency within the 225.00 to 399.95 Mc band limits. The selectors control the hundreds, tens, units, tenths and hundredths digits of the desired frequency in megacycles. The manually selected frequency is indicated on a manual frequency selected window placarded Mc. The mode selector switch must be in the MAN position for manual frequency selection.

SQ Disable Switch. The SQ disable switch is placarded SQ DISABLE with two positions; OFF and ON. The OFF position permits signal to noise squelch operation while the ON position disables the squelch circuits.

Note

The SQ disable switch must be in the OFF position for retransmit operation.

Volume Control. The volume control is placarded VOL and rotation adjusts the level of audio signals delivered to the pilot's headset.

Preset Channel Indicator. The preset channel indicator shows the channel selected by the preset channel selector.

Intercom Function Selector Switch. The intercom function selector switch position T/R LIA which was previously inoperative is now utilized when the back-up communication system is desired. With the

switch in the T/R LIA position and the microphone button depressed the ARC-70 radio-transmit function is disabled and transmitting is through the radio set in the pod selected by the power switch and tune select switch on the control panel.

Operating Procedures.

The operating procedures for the radio relay system is as follows:

- a. Mode selector switch — MAN or PRESET CHAN.

If MAN is selected, rotate the manual frequency selectors to the desired frequency for radio No. 1.

If PRESET CHAN is selected, rotate the preset channel selector to the channel which contains the desired frequency for radio No. 1. Radio No. 1 will tune to the frequency selected.

- b. SQ disable switch — OFF.
- c. Power switch — RETRAN.
- d. Tune select switch — UHF 1.
- e. Tune select switch — UHF 2.

- f. Mode selector switch — MAN or PRESET CHAN.

If MAN is selected, rotate the manual frequency selectors to the desired frequency for radio No. 2. If PRESET CHAN is selected, rotate the preset channel selector to the channel which contains the desired frequency for radio No. 2. Radio No. 2 will tune to the frequency selected.

Note

While radio No. 1 and 2 are tuning to the frequencies selected, an 800 cycle tone will be heard in the headset.

- g. The system will now function as a radio relay. Signals being relayed between stations will be heard on the headset and volume level may be adjusted with the volume control.

Note

If a frequency change is desired, the tune select switch must be indexed to corre-

spond to the radio for which the frequency change is desired.

- h. To utilize either of the relay pod radios as a back-up for the ARC-70 command radio, index the intercom function selector switch to T/R LIA.

Note

When the intercom function selector switch is positioned to T/R LIA the ARC-70 transmit function is disabled. ARC-70 side tone will still be present in the headset so that GUARD and MAIN channel may be monitored.

- i. Power switch and tone select switch — Position corresponding to radio to be used.
 - j. Mode selector switch — MAN or PRESET CHAN
- If MAN is selected, rotate the manual frequency selectors to the desired frequency. If PRESET CHAN is selected, rotate preset channel selector to the channel which contains the desired frequency. The selected radio will tune to the selected frequency.
- k. To transmit, depress the microphone button.

TRANSPONDER/ANTENNA SYSTEM — SST-181X

☐ [D-692] C/W ☐ [F-546] C/W.

The transponder/antenna system is installed in ☐ aircraft in accordance with [D-692] and in ☐ aircraft in accordance with [F-546]. The control panel is located on the top of the main instrument panel and incorporates a transponder switch and an indicator light. The system is powered by DC secondary power.

Transponder Switch.

The transponder switch has two positions, ON and OFF.

Operating Procedures.

To activate the transponder/antenna system, position the transponder switch to ON.

TAPE RECORDER SYSTEM - 14 CHANNEL**F[F-548] C/W**

The 14 channel tape recorder system functions to record information provided by certain aircraft systems during a flight. At the end of a flight, the recorder, located on the right console, is removed from the aircraft and operated in conjunction with a ground playback system to reconstruct and evaluate the mission. The system is powered by secondary DC and AC power.

Inputs to the tape recorder are as follows:

Aircraft System	Input
AGM78 Assessment	Video/audio from launched missile
AGM-78A or AGM-78B Missile Control	Missile system status
Radar Homing and Warning Visual displays and mode of operation	
AIC/20 Intercom	Audio (UHF, intercom and Radar Homing and Warning)
Doppler Navigation	Latitude, longitude, true heading, ground speed and Drift Angle
CADC	True angle of attack, calibrated airspeed and altitude
Accelerometer	Acceleration signal
All Attitude Reference	Pitch and Roll

Power Switch

The power switch, located on the left console rear cockpit, is a two position switch placarded POWER with positions marked ON and OFF.

The ON position energizes the system power supply, energizes the cooling blower in the aircraft missile interface, and activates a thermal blanket in the recorder unit. The thermal blanket maintains the recorder tape deck at a constant temperature. An internal time code is also energized which will start when the aircraft weight is off the wheels (takeoff) and will continue until either the aircraft weight is on the wheels (touchdown) or the power switch is indexed to OFF.

Record Switch

The record switch, located on the left console rear cockpit, is a momentary contact switch spring loaded to the mid (neutral) position. The two positions are marked RECORD and STOP. Momentarily positioning the switch to RECORD activates the tape recorder and illuminates the RECORD light on the control panel. Momentarily positioning the switch to STOP, stops the tape recorder and illuminates the STOP light on the control panel.

AGM-78 Assessment System

The AGM-78 assessment system functions to provide information on the operation of a launched AGM-78 missile. The system consists of an assessment antenna, a receiver and a BDA volume control. RF signals transmitted by the launched missile are detected by the assessment antenna and applied to the receiver. The receiver functions to convert these RF signals into video and audio signals. The video and audio outputs of the receiver are applied to the recorder control unit of the 14 channel tape recorder system. The audio output is also applied to the AIC-20 intercom system through the BDA volume control.

QRC-373 (BORDERS) SYSTEM [1079] C/W.

The QRC-373 system consists of four separate transmitting systems each covering a separate frequency

band. The four systems may be operated separately or simultaneously depending on mission requirements. The system consists of two antennas, two duplexers, four transmitters, a relay box and a control panel. The antennas are mounted on the inside top portion of the R14 radar radome. The control panel is mounted on the lower right corner of the windshield bow and contains four switches and four indicator lights (one for each band). The system is powered by 28 volt DC power.

IDENTIFICATION RADAR (AN/APX-37).

The AN/APX-37 identification radar set provides automatic selective identification of the aircraft in which it is installed when properly challenged by surface or airborne radar sets. The set can also identify the aircraft in which it is installed as a friendly aircraft within a group of specific friendly aircraft. Supplementary purposes are to provide momentary identification of position upon request and to transmit a specially coded response to indicate an emergency. In operation, the AN/APX-37 set receives coded interrogation signals and transmits coded reply signals to the source of the challenging signals where the reply codes are displayed, together with associated radar information (targets, etc.) on the radar indicators. When a radar target is accompanied by a proper reply code from the IFF set, the target is considered friendly. Three modes of operation are provided for response to interrogation signals: Mode 1 (SI), Mode 2 (PI) and Mode 3 (TI), security identification, plane identification and traffic identification respectively. The SIF (selective identification feature) control panel is used in conjunction with the IFF control panel, providing for elaboration of the reply coding through the many code combinations available with the SIF control panel. Normal power to the AN/APX-37 system is from the (CIN) integrated power supply which is powered by DC primary, and AC secondary power. The IFF/SIF set is normally powered by the DC CIN power supply modules. If certain DC powered CIN modules fail, the IFF/SIF set will be inoperative. This is indicated by illumination of a caution light on the caution light panel which displays CIN PWR (ELEC SYS CNTRL PWR). The IFF/SIF emergency mode will be automatically turned on when the canopy is jettisoned or unlocked manually if the MASTER switch is in LOW or NORM and the nose gear is up and locked.

Note

If the SIF control panel is not installed, the Mark X SIF operation will not be

available; however, the set will still operate in all three IFF modes and emergency operation, providing limited preset interrogation and response signals.

Identification Radar Control Panels.

Two radar control panels (figure 1-44) (not in rear cockpit) marked SIF and IFF are located on the right console. The IFF transponder control panel contains two mode switches — an I/P (identification of position) switch, and a five-position, master switch with positions of OFF STDBY, LOW, NORM and EMERGENCY. The SIF code-selector panel contains two concentric rotary code-selector switches used to select the code signals for Mode 1 or Mode 3 SIF. The MODE 1 selector-switch contains an outer knob marked 0 to 7 and an inner knob marked 0 to 3. The MODE 3 selector-switch knobs are both marked 0 to 7. When DC power is turned on and the MASTER switch is in the LOW, NORM, or EMERGENCY position, a time-delay prevents operation for 70 seconds to permit the system to warm up. After DC power is on, when the MASTER switch is in the OFF position, the system is in a partial standby condition and will not operate when the MASTER switch is placed in LOW, NORM, or EMERGENCY position until after a 15-second delay. When the MASTER switch is in the STDBY position, the system is inoperative but ready for instant use. In the LOW position, the transponder operates at reduced sensitivity and replies only in the presence of strong interrogation. In the NORM position, the transponder operates at full sensitivity which provides maximum performance. In the EMERGENCY position, the transponder will respond to mode 1 (and mode 2 and 3 if the MODE 2 and MODE 3 toggle switches have been actuated) interrogations with an emergency signal. With the three toggle switches in the OUT position and the MASTER switch in LOW or NORM, the transponder will reply only to mode 1 interrogations with the code set on the MODE 1 rotary code-selector switches. When the MODE 2 toggle switch has been set to operate position, the transponder will reply to mode 1 and mode 2 interrogations with an aircraft assigned code which is preset on the ground and cannot be changed in flight. When the MODE 3 toggle switch is set to the operate position, the transponder will reply to mode 1 and mode 3 interrogations with the codes set on the MODE 3 rotary code-selector switches. The I/P (identification of position) switch has three placarded positions, I/P, OUT and MIC and is spring-loaded out of the I/P position to OUT. When I/P is requested, the

IFF/SIF AN/APX-37 control panels

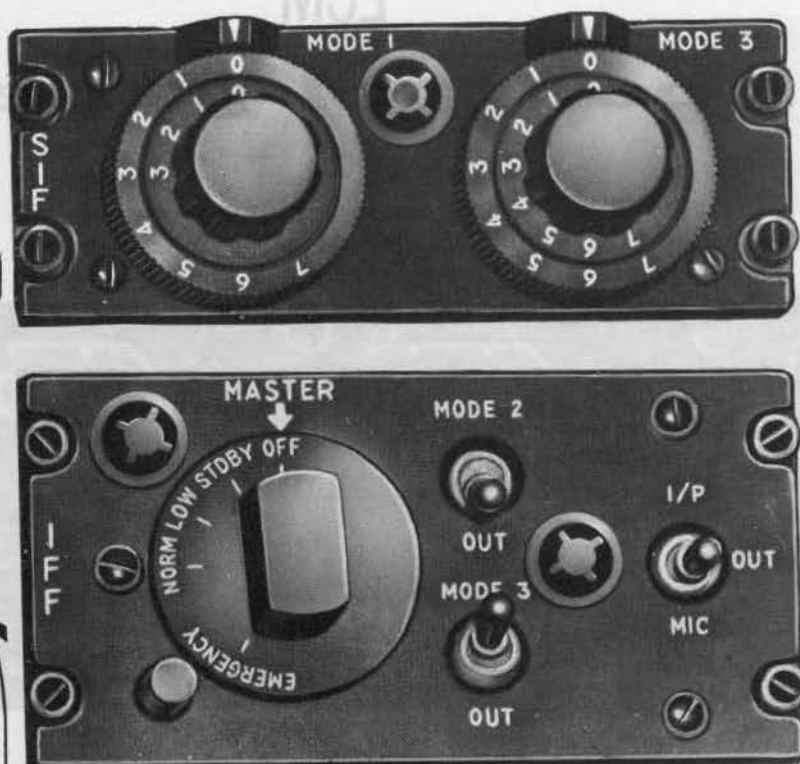
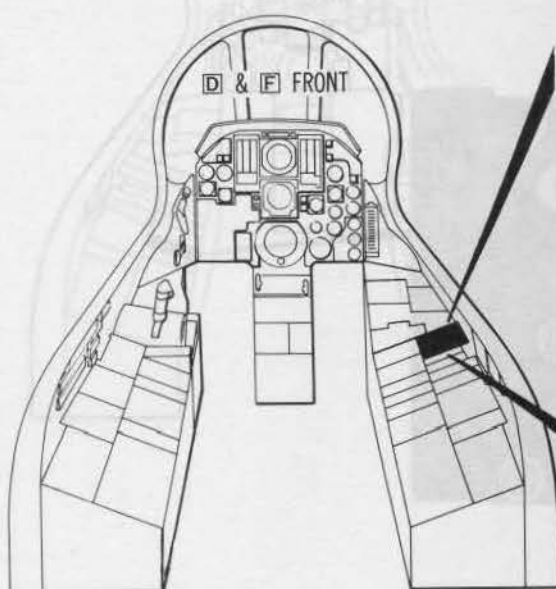


Figure 1-44

pilot actuates the switch to I/P and releases it. A double reply of mode 1 or mode 3 (depending on the position of the MODE 3 toggle switch) will be transmitted for about 30 seconds, if the transponder is properly interrogated. When the MIC position is selected, operation is the same as I/P whenever the microphone button is depressed.

Operation of AN/APX-37 Radar.

1. Rotate master switch to STDBY to maintain equipment inoperative but ready for instant use.
2. Rotate master switch to NORM to place equipment in operation. Use LOW only when requested.
3. Set mode 2, mode 3, and I/P switches OUT unless otherwise directed.
4. For emergency operation, press dial stop and rotate master switch to EMERGENCY so that the set will automatically transmit the special coded distress signal in response to interroga-

tion. Set mode 1 and mode 3 code selector switches on the SIF control panel as directed by the following current geographic publications for:

- a. ZI-NORAD IFF/SIF Instruction Publication.
- b. PACAF-Procedures for the use of IFF Mark X (SIF) in the Pacific Command.
- c. USAFE-EUCOM/IFF Mark-X (SIF) Operational Instructions (U).

Note

If the IFF/SIF squawk is not being received by the ground station, recycling of the IFF/SIF master switch may cause normal operation. If this procedure does not cause normal operation *pull and reset* the IFF ANT LOBING PWR circuit breaker.

5. Placing the master switch at OFF puts the set in a partial standby condition. To turn it off completely, the IFF PWR circuit breaker must be pulled out.

ECM control panel

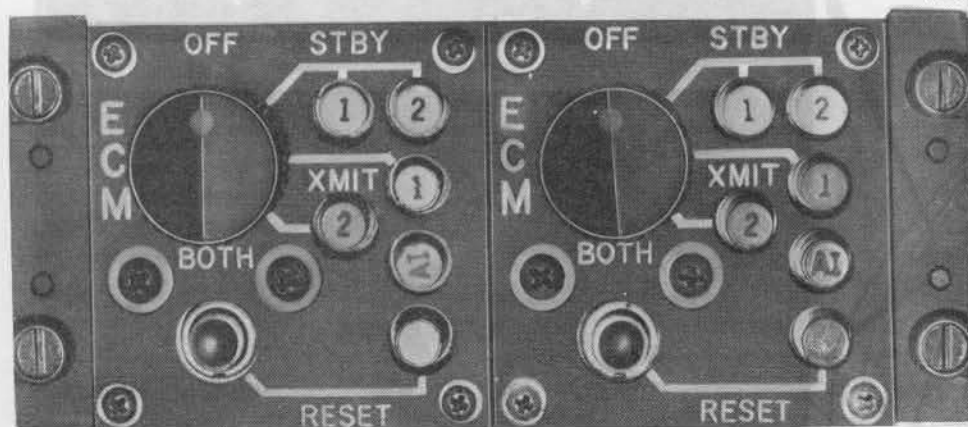


Figure 1-45

ELECTRIC COUNTERMEASURES (ECM) SYSTEM QRC-160 [890] C/W.

A QRC-160 ECM pod may be carried on one or both outboard wing station pylons for use in jamming defensive radar system. When one ECM pod is carried either a QRC-160A-1 or QRC-160A-2 pod is used depending on the specific type of jamming desired. Separate control panels for each pod contain the controls and indicators necessary for the operation of the respective pod (system) during flight. The ECM pods are self contained systems and require no aircraft electrical power for operation. Power for operation of the system is provided, when the aircraft is airborne, by a wind driven ram air turbine AC generator located on the ECM pod. Aircraft DC secondary power is required for illumination of the trouble indicator light on the control panel.

ECM Control Panel [890] C/W.

Two identical control panels (figure 1-45) on the right console (not in rear cockpit) are placarded ECM and contain the necessary controls and indicators for operation of the ECM system. The left control panel controls operation of the ECM pod on the left outboard pylon and the right control panel controls operation of the ECM pod on the right

outboard pylon. The description and function of the controls and indicators are as follows:

Operate Knob [890] C/W. The operate knob (figure 1-45) on the ECM control panel has five positions: OFF, STBY, two XMIT positions (XMIT 1 and XMIT 2) and BOTH. The OFF position turns the system OFF. The STBY position applies power to the system and places it in standby. The first XMIT position (clockwise from OFF) places the system ON. The second XMIT position places a second ECM pod system ON if two pods are carried on a pylon. This position is not used on the present aircraft configuration. The BOTH position is not used on the present aircraft configuration; however, if two pods are carried on one pylon station it would place both systems ON.

STBY 1 Indicator Light [890] C/W. The STBY 1 indicator light (figure 1-45) is a white light displaying the numeral 1 when illuminated. Illumination of the light indicates that the system is in standby operation. The light should illuminate within three minutes after the operate knob is placed at STBY.

STBY 2 Indicator Light [890] C/W. The STBY 2 indicator light (figure 1-45) functions the same as the 1 indicator light if a second ECM pod is carried on the same pylon. This light is not utilized on present aircraft configuration.

Transmit 1 Indicator Light [890] C/W. The transmit 1 indicator light (figure 1-45) is a green light displaying the numeral 1 when illuminated. Illumination of the light indicates the system is radiating. If the system is operating in normal mode, the light illuminates only after the transmitter is locked on or tuned to a radar signal by the receiver. If the system is operating in the action mode the light illuminates whenever the operate knob is placed at XMIT.

Transmit 2 Indicator Light [890] C/W. The transmit 2 indicator light (figure 1-45) functions the same as the Transmit 1 indicator light if a second ECM pod (system) is carried on the same pylon and radiating. This light is not utilized on the present aircraft configuration.

A1 Indicator Light [890] C/W. The A1 indicator light (figure 1-45) is a red light displaying A1 when illuminated. Illumination of the light indicates the system is jamming enemy radar signals. The light is operative on the control panel used with the QRC-160A-2 ECM pod, and inoperative on the control panel used with QRC-106A-1 ECM pod. The A1 indicator light is used with ALQ-101 to indicate power is being applied to the pod.

Trouble Indicator Light [890] C/W. The trouble indicator light (figure 1-45) is a red light and when illuminated indicates an overvoltage, overcurrent or underpressure condition in the pod (system). When this occurs, power must be removed from the system power supply by pressing the Reset button. When the light flashes it indicates an overheat condition in the ram air turbine (RAT) generator system, and power must be removed by pressing the reset button. This light is the only function of the ECM system requiring aircraft electrical power and is powered by DC secondary power.

Reset Button [890] C/W. The reset button (figure 1-45) is a spring-loaded pushbutton switch used to reset the ECM system when the trouble indicator light illuminates. When the button is depressed and held with the operate knob in the XMIT 1 position, the transmit 1 indicator light will go out and the system will revert to standby operation (however, the STBY light will not illuminate). If the trouble light goes out the button is released and the transmit 1 indicator light will again illuminate. If the trouble light does not go out, the system has an underpressure condition and the system operate knob should be placed OFF. If the trouble light flashes when the reset button is depressed it indicates an overheat condition in the RAT generator and the system operate knob should be placed OFF.

ECM Operation [890] C/W.

Pre-Takeoff Procedures:

1. Check outboard pylon cable plug is connected to the QRC-160 connector in the wheel well.
2. Check QRC-160 coaxial cable plug is connected to the QRC-160 POD connector in the wheel well.

In-flight Procedures:

1. Operate knob — STBY (min 250 KCAS). STBY 1 light should illuminate within three minutes.
2. Operate knob — XMIT one position.
3. Transmit 1 light illuminates when the operate knob is placed at XMIT when the ECM system is operating in the action mode. In the normal mode of operation the transmit 1 light illuminates only after the transmitter is locked-on or tuned to an enemy radar signal by the receiver.
4. When the QRC-160A-2 ECM pod is in operation, the A1 indicator light of the respective control panel will illuminate when the system is jamming enemy radar signals.
5. If the trouble indicator light illuminates, proceed as follows:
 - a. Momentarily depress and hold reset button. Trouble light should go out, and the system returns to standby (standby indicator light will not illuminate). This indicates an overcurrent or overvoltage condition occurred in the system.



If the system does not reset after the reset button is released, immediately place the operate switch OFF.

- b. If trouble light does not go out when reset button is depressed and held, the system has an underpressure condition, and should be shut down by placing the operate knob OFF.
- c. Flashing of the trouble indicator light when the reset button is depressed and held or when the system is shut down an overheat

condition exists in the RAT generator and the system operate knob should be placed OFF.

6. Operate Knob — OFF, to shut down system.

ALL ATTITUDE GYRO SYSTEM.

The all attitude gyro system is a central master gyro reference system that provides attitude and azimuth information to the following systems and/or instruments.

- All attitude compass system.
- Doppler Navigation system.
- Toss bomb computer.
- Optical sight system.
- AFCS (automatic flight control system).
- HSI (horizontal situation indicator).
- ADI (attitude director indicator).

The tie-in with the above systems and/or instruments is explained in detail elsewhere in this section. The system consists of a vertical gyro and a directional gyro mounted to permit unlimited movement in the roll, pitch and yaw axes of the aircraft, hence they continuously provide roll, pitch and azimuth information in all flight attitudes. The directional gyro is pitch and roll stabilized, and the vertical gyro is mounted to prevent gimbal lock thus preventing loop and gimbal error normally associated with vertical and directional gyro systems. This is possible because erection and levelling devices keep the gyro axes in their respective vertical and horizontal planes. There are two synchro transmitters on each of the three axes of the reference system. Continuous signals from these synchros are fed to aircraft systems requiring pitch, roll and azimuth information, the gyros are erected and attain operating speed in less than 60 seconds after the application of DC and AC primary power. Full gyro speed is attained in less than three and one half minutes.

Vertical Gyro Fast Erection Button

The vertical gyro fast erection button (33, figure 1-3) is a momentary contact push button switch placarded VERT GYRO FAST ERECT. The button is used by the pilot to rapidly correct errors in indicators due to aircraft acceleration effect on the vertical gyro. Depressing the button starts gyro

erection at rates of at least 15 degrees per minute, provided the function selector has been at DG or SLAVED for one minute and interrupts any operating AFCS pilot relief mode (except MACH which disengages). Mach hold can be manually engaged two seconds after the button is released and other previously engaged modes will be immediately functional when the button is released. STAB AUG operation is not affected by actuation of this button. The pitch steering bar provides an accurate presentation of pitch error only in straight and level flight. When the pitch steering bar has centered within four bar widths on the ADI, the gyro can be considered fully erect, and the button must be released. With the button out, the normal rate of erection is 1.3 degrees per minute. The button erection circuit is powered by DC primary power.

CAUTION

Do not hold this button depressed continuously over 30 seconds, and allow a 90 second interval between each use for cooling to prevent damage to slewing motors and electrolytic erection switches of the all attitude vertical gyro.

Note

Fast erections should only be used in wings level unaccelerated flight.

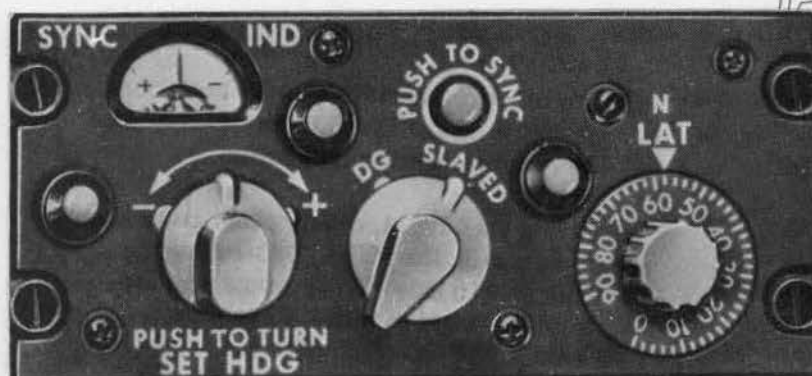
- After the gyro is fast erected the ADI pitch steering bar may oscillate slowly about a null position while the vertical gyro fast erect button is depressed.
- While the vertical gyro fast erection button is held depressed, the attitude warning (OFF) flag on the ADI will appear. However attitude information is reliable.
- The electrical signals from the all attitude system serve many systems. When this button is depressed, the Fire Control System, AFCS, and the ADI are also affected, and are covered in detail under the above paragraph heads in the section.

NAVIGATION EQUIPMENT.

ALL ATTITUDE COMPASS SYSTEM.

The compass system may be used as a directional gyro corrected for apparent drift due to the earth's

COMPASS control panel (ALL ATTITUDE)



F Control transfer button in each cockpit. Shown illuminated for information only.

Figure 1-46

rotation, or as a magnetic compass. Heading information is provided for flights at all latitudes. The system consists of a directional control gyro, compass adapter, third gimbal controller, rate switching gyro, and an amplifier power supply of the all-attitude reference system located in the right aft equipment compartment, a control panel (figure 1-46) located on the right console and a remote compass transmitter (magnetic flux valve) located in the vertical fin. Instruments in the cockpit that receive heading information from the compass system's directional control gyro are the bank-steering bar of the attitude director indicator, and the compass card of the horizontal situation indicator. In the magnetic (SLAVED) mode, the system is basically a gyro stabilized magnetic compass slaved to the remote compass transmitter and actuate within ± 0.5 degrees. Heading indication in relation to magnetic north are given without northerly turning error or oscillations. However, at high latitudes, this mode is subject to error caused by extensive changes of the earth's magnetic field in the proximity of the earth's magnetic poles. In the directional gyro (DG) mode, the system is free of magnetic influence since the gyro is not slaved to the remote compass transmitter. Heading indications are given by a latitude-corrected directional-gyro made to

precess proportionally as required to correct for apparent gyro drift due to the earth's rotation which varies with latitude. This mode is primarily utilized for navigation in the high latitudes or polar regions where use of the magnetic mode is impractical; however, it may be used at all latitudes if desired. Provision is made for selection of flight latitudes and hemisphere to control precession rate and direction of latitude correction. The compass system also serves as a directional reference for the automatic flight control system and a heading reference for the Doppler navigation system. The system is powered by three 115 volt phases of AC primary power, and by DC primary power, and is energized whenever primary power is available.

NAV Control Transfer (Take-Over) Buttons. F

The NAV control transfer (take-over) button (figure 1-62) permits transfer of compass control between cockpits and is powered by DC primary power. A circuit interlock, will prevent NAV control transfer unless the Doppler system heading reference switch is at DG or MAG, and although the NAV take-over button can be depressed, it will not remain engaged. Refer to DOPPLER SYSTEM in this section as the same control transfer button is used for each system.

Note

- Ⓕ If the function selector knob in the cockpit taking over the NAV function is at SLAVED, the AFCS pilot relief mode (if engaged) will disengage when the NAV take-over button is depressed. If the function selector knob is at DG the pilot relief mode will not disengage.
- When the NAV control is transferred from one cockpit to the other the HSI compass cards in either or both cockpits may fluctuate and/or oscillate. The amount of fluctuation and/or oscillation will vary and depends on flight conditions, system tolerance, and synchronizing error. A heading change may occur when the fluctuations and/or oscillations end. To minimize the heading change on the HSI compass cards during NAV transfer the sync button should be depressed during straight and level flight and the synchronizing indicator needle should be approximately centered prior to depressing the NAV takeover button. This will prevent a heading change on the HSI compass cards from exceeding two degrees. The change error will be removed automatically by the slow slave system (1 to 2 degrees per minute) and the HSI compass cards should return to the proper heading.
- Display of heading on the HSI in both cockpits is continuous regardless of take-over button positions.
- Compass sync error will be displayed only when the compass functions selector switch in both cockpits is at SLAVED.

Function Selector Knob.

The two-position function knob (figure 1-46) with positions of SLAVED and DG, is used to select the mode of operation of the compass system. The DG position selects directional-gyro mode, and the SLAVED position selects the magnetic slaved mode.

Set Heading Knob and Synchronization Indicator.

The set heading knob (figure 1-46) located on the compass panel is used when in directional-compass mode to position the compass card to the desired gyro heading. The knob has a detented position at

the top center and must be depressed to move to the left (-) decrease position, or to the right (+) increase position. The direction of movement of the knob is determined by whether an increased or decreased heading position is desired. When in SLAVED mode, minor corrections to insure synchronization may be made by the set heading knob. Lack of synchronization between the remote compass transmitter and the gyro heading is indicated when the synchronization indicator remains off center. This indication is marked SYNC IND and is located in the upper left corner of the compass control panel.

Note

- Ⓕ The function selector knob in both cockpits must be at SLAVED for operation of the synchronization indicators.
- During taxi, flight, or any other conditions of vibration, the SYNC IND will swing from side to side. The average position should be used to judge if needle is near zero.

If the needle remains a large amount off center, the PUSH TO SYNC button should be used to center the needle. Upon releasing this button the needle may jump off center a small amount. This error will be removed by gyro slaving in a short time. If desired the set heading knob may be used to remove synchronization error. The direction of displacement of the set heading knob is determined by the displacement of the SYNC IND. When the needle is off center to the plus (+) side, the set heading knob is moved in the plus (+) direction to the desired rate of slaving until the SYNC IND needle swings to the center position. If the needle is minus (-) the knob is moved to the minus (-) position to center the needle.

Note

Heading reading in SLAVED mode will be subject to error if not synchronized. Check synchronization before taking readings.

- In the DG mode, the SYNC IND is inoperative and the needle will be centered.
- When the set heading knob is depressed, the AFCS pilot relief mode will be interrupted.

Hemisphere Selector Screw and Indicator.

The hemisphere selector screw (figure 1-46) on the compass control panel is used only in the DG mode to select the hemisphere in which the aircraft is operating. A small window beside the screw displays N or S to indicate the hemisphere selected.

Latitude Correction Knob.

The latitude correction knob (figure 1-46) on the compass control panel is used to rotate a circular dial at the base of the knob placarded LAT. The dial is numbered from 0 to 90 to indicate degrees and has a mark for each two degrees. The latitude correction knob and dial are operative only in the DG mode and are used to select the latitude in which the aircraft is operating. When in DG position, with the operating latitude selected, the directional gyro will be corrected automatically for apparent drift caused by the earth's rotation.

Note

The proper corrections will not be made if the hemisphere selector screw is not indicating the correct hemisphere.

Synchronizing Buttons.

The synchronizing button (figure 1-46) located on the compass control panel in and marked PUSH-TO-SYNC, is used in the SLAVED mode to instantly and automatically synchronize the compass card of the HSI to the remote compass transmitter. In the **[E]** when the button is momentarily depressed a holding circuit is activated until the compass system is synchronized. In the **[D]** the system will slew only so long as the button is depressed. In the **[E]** automatic synchronization of the system to the remote compass transmitter occurs whenever the system is switched from the DG to SLAVED mode of operation. In the **[D]**, automatic synchronization of the system to the remote compass transmitter occurs for approximately 13 seconds whenever the system is switched from the DG to SLAVED mode of operation. In the **[D]**, if the system has to be resynchronized for any reason while in the SLAVED mode, momentarily depress the push-to-sync button to instantly and automatically synchronize the compass card of the HSI to the remote compass transmitter without any further attention from the pilot. The holding circuit automatically disengages when the system is synchronized. In the **[E]** if the system has to be resynchronized for any reason while in the SLAVED mode, the button must be held depressed until the system is synchronized.

Note

When this button is depressed the AUTO PLT button will disengage (pop up). The

AUTO PLT button cannot be reengaged (stay in when depressed) until the automatic synchronizing cycle is completed. In turbulent air this may take up to 20 seconds.

Bomb Mode Gyro Erection Button.

The bomb mode gyro erection button is a two-position, pushbutton, switch placarded BOMB MODE GYRO ERECT and PULL TO CUT OFF which becomes operable when the Bomb-Nav switch is at BOMB. When pulled out, it illuminates displaying BOMB MODE ERECT OFF and cuts off normal vertical gyro erection power to prevent a false reference caused by fore-aft acceleration. Normal erection is also cut out by any yaw or turn rate over 15 degrees per minute. It must be left out until completion of a bomb run. It must be pushed in after completion of the run to avoid accumulation of drift errors in the vertical gyro in case the Bomb-Nav switch is inadvertently left at the BOMB position. Proper erection is indicated when the pitch steering bar is within four bar widths of the miniature aircraft on the ADI. The button illuminates when actuated (pulled out) and the light is powered by AC primary power.

Normal Operation of the Compass System.

In the **[E]**, the function selector knob on the compass control panel in both cockpits must be at SLAVED or the synchronizing indicators in both cockpits will be inoperative.

Note

- [E]** Prior to operation, the pilot who takes command of the compass system must depress the NAV-take-over button in his cockpit.
- The Doppler heading reference switch must be at DG or MAG before depressing the NAV-take-over button.

Slaved Operation.

- [E]** 1. Function selector knob — SLAVED (both cockpits).
2. Allow a minimum of 90 seconds warmup time after AC and DC primary power is applied. When power is initially supplied, or when switching from the DG to SLAVED mode, the system will automatically fast synchronize (slave) at 50 degrees per second to the remote compass transmitter. After the initial fast

synchronize cycle, the system returns to the normal slaving cycle.

3. The heading displayed by the compass card of the HSI should show the actual aircraft heading. (Check with magnetic compass or known runway heading.) When the instrument selector switch is in the MANUAL position, an exact readout is obtained from the course selector window.
4. The synchronization needle should have moved to the center (null) position indicating synchronization of the compass card and remote compass transmitter. The needle may jump off center at the end of the sync period, but it will recenter by slaving the gyro to the slaving amplifier null.
5. If necessary, manual synchronization can now be accomplished by depressing the synchronization button until the needle moves to center. The compass card of the HSI should rotate smoothly to actual aircraft heading. The synchronizing button may be used at any time to obtain synchronization and will not produce a hard-over signal if used during AFCS operation, as an automatic cutout switch will uncouple the AFCS from the system.

Directional Gyro Operation.

1. Function selector knob — DG.
2. Allow a minimum of 90 seconds warmup time after system is energized.
3. Check hemisphere selector screw on N or S according to hemisphere in which flight is made. The gyro will now precess in the proper direction.
4. Set latitude correction knob on present latitude to govern rate of precession.
5. The compass card of the HSI will now show turns and headings without signals from the remote compass transmitter. The compass card of the HSI is set by rotating the synchronizer knob clockwise for increasing indication, or counterclockwise for decreasing indication with the choice of either fast or slow slewing rate. A known runway heading can be used as a reference or the SLAVED mode may be used to establish an initial heading reference.

Note

As the aircraft passes through different latitudes in flight, the latitude correction knob should be rotated to the new latitude every two degrees of latitude change.

CLOCK



Figure 1-47

CLOCK.

The clock (figure 1-47) is a mechanical, stem-wound, eight-day clock, and is internally lighted. One scale with four pointers is provided on the face of the clock.

The knob on the lower-left corner of the case winds, sets, and starts the clock as follows:

Turn — Winds clock.

Pull — Stops clock, (minute and hour hands).

Turn — Sets clock.

Push — Starts clock.

The button on the upper-right corner of the case starts, stops, and reset the elapsed minutes and seconds pointers as follows:

Push — Starts pointers (seconds and minutes).

Push — Stops pointer.

Push — Resets pointer to zero.

STANDBY INSTRUMENTS.

Note

This paragraph covers only those instruments which cannot be considered as integral parts of a complete system, such as fuel system, engine, etc.

PITOT STATIC SYSTEM.

The pitot-static system supplies pitot pressure to the standby airspeed indicator, airspeed switch, landing gear altitude warning switch and the air data computer. Static pressure is applied to the air data computer, the standby airspeed indicator, standby altimeter, airspeed switch and the landing gear altitude warning switch. The pitot-static tube is mounted on the end of the nose boom and incorporates an anti-icing electric heating element powered by DC primary power.

STANDBY AIRSPEED INDICATOR.

The standby airspeed indicator (30, figure 1-3), which visually presents indicated airspeed to the pilot, is direct reading, and requires no electrical power for operation. An airspeed mechanism actuated by pitot and static pressures moves a pointer on the face of the instrument over a fixed scale, whose limits are from 100 to 400 knots. The scale is graduated in 10 knot increments up to 300 knots, and 50 knot increments from 300 to 400 knots. Indicator readings are in terms of indicated airspeed (IAS) and have a tolerance of plus three minus five knots up to 300 knots. The position error correction shown in figure A1-2 must be added to the IAS values to obtain calibrated airspeed (CAS).

Note

- Ⓛ Some aircraft have an indicator whose limits are from 50 to 850 knots. The tolerance on these indicators is plus or minus five knots up to 300 knots.

STANDBY ALTIMETER.

The standby altimeter (31, figure 1-3) provides the pilot with a visual indication of barometric altitude, is direct reading, and requires no electrical power for operation. An aneroid, actuated by static pressure, moves three pointers on the face of the instrument over a fixed scale which is graduated in 20 foot increments with a major division every hundred

feet from zero to one thousand feet. The larger pointer indicates hundreds of feet and makes one revolution for each 1000 feet of altitude. The intermediate pointer indicates thousands of feet and makes one revolution for each 10,000 feet of altitude. The small pointer indicates ten thousands of feet. The pointers and barometric scale can be set by turning the knob in the lower left corner of the instrument. To determine altimeter error, the pilot sets the base altimeter setting on the barometric scale, then notes the indicated altitude, which should be compatible with known field elevation. On some standby altimeters the instrument error at field elevation can be eliminated by turning the knob to set the local base barometric pressure then pulling the knob out and turning to adjust the large pointer to indicate actual known field elevation. To determine true altitude the altimeter readings must be corrected by adding the position error shown in figure A1-1 and B1-1.

CAUTION

If the knob is inadvertently pulled out during flight while setting the barometric scale, the altitude reading will also be changed and will then be in error.

MAGNETIC COMPASS.

A conventional magnetic compass (not in rear cockpit) suspended from the windshield bow is furnished for navigation in case of instrument or electrical system failure. Illumination of the light within the compass case is controlled by the flight instrument rheostat on the right console. The compass is accurate within plus or minus three degrees with the canopy closed and the engine and all systems operating normally.

STANDBY ATTITUDE INDICATOR.

A two-inch standby attitude indicator (29, figure 1-3) is incorporated to provide an independent attitude indicating system in the event of failure of the Attitude Director Indicator (ADI) of the integrated flight instrument system or the All-Attitude Compass System. The Attitude Indicator displays pitch and roll attitude information obtained from a remote gyro which drives the indicators. The sphere displays continuous reliable attitude information through 360 degrees of roll and up to 82 degrees in pitch (dive or climb). Between approximately 82 and 110 degrees in pitch, controlled precession occurs. The indicator and gyro are normally powered by

three-phase AC primary power with the inverter switch in the STAND-BY position. If the ATM, or AC generator fails, the indicator utilizes primary DC power converted to AC by the standby inverter. Gyro erection is automatic and the attitude warning (OFF) flag will disappear approximately 60 seconds after application of power. The flag will appear if there is a power failure, power removal or if any phase drops out. A pitch trim knob is provided on the indicator to reposition the sphere as required in level flight.

CAUTION

Continuous operation of the fast erect button is limited to 30 seconds followed by a one-minute cooling period to prevent damage to the slewing motors and electrolytic erection switches of the all-attitude system vertical gyro.

- While the fast erect button is held in, the attitude warning (OFF) flag will be in view, indicating that the attitude information displayed is unreliable.

Note

There are no automatic erection cut-out provisions in the standby attitude indicator system and after prolonged accelerations accumulated errors will be indicated.

- The standby-attitude-indicator can be fast erected during level unaccelerated flight by depressing and holding the VERT GYRO FAST ERECT button approximately 30 seconds. The attitude warning (OFF) flag will appear during fast erection on some aircraft.

INTEGRATED FLIGHT INSTRUMENT SYSTEM (IFIS)

The integrated flight instrument system (IFIS) (figure 1-48) consists of four flight instruments arranged in a group on the center of the main instrument panel, a flight director computer and a signal data converter. Supporting systems which integrate with and supply information to the (IFIS) are the all attitude gyro system, the central air data computer and the radio and navigation equipment. The system is designed to present actual and command flight and navigational information

in a clear and compatible manner. Flight information (airspeed, altitude, vertical velocity, and Mach number) is presented on moving tapes and indicates on two of the instruments, the Airspeed-Mach Indicator (AMI) and Altitude-Vertical Velocity Indicator (AVVI). Additional flight and navigational information is presented on the Attitude Director Indicator (ADI) and the Horizontal Situation Indicator (HSI). In the **F** the integrated instruments in the front and rear cockpit operate independently of each other from electrical signals supplied by the supporting systems. The flight director computer and signal data converter of the (IFIS) process and channel the various signals from the radio and navigation equipment to the proper indicators for presentation to the pilot. The system is capable of operation in seven modes and two submodes. Presentation on the indicators in various modes are shown in the switching chart for the instrument selector switch (figure 1-55).

Note

- F** The integrated flight instruments in the front and rear cockpits are operated independently and are not repeater indicators.

Central Air Data Computer System.

The central air data computer system (figure 1-49) collects, computes, and transmits critical data about the immediate atmosphere through which the aircraft is flying, the relationship of the aircraft to that atmosphere and, in particular, the angle of attack and airspeed. The data is then supplied to the following systems: AFCS (automatic flight control system), flight control (pitch continuously variable M.A.), variable air inlet, bombing, and navigation. The system is composed of the computer, converter, static pressure and angle of attack compensator, the angle of attack sensor, pitot tube and the temperature probe. The computer is the central unit that takes data from the pitot tube, computes and transmits that data as electrical signals to the converter which organizes, adapts, and distributes it to the particular aircraft systems. The converter supplies the required information outputs, eliminating duplication of computers for each system. The inputs to the computer, defined by the airstream surrounding the aircraft, are the static pressure, total pressure, indicated temperature and the angle of attack and are detected by pressure and temperature probes and an angle of attack sensor. Receiving the sensed inputs, the computer converts them to mechanical actions that actuate cam and gear

INTEGRATED FLIGHT INSTRUMENT system

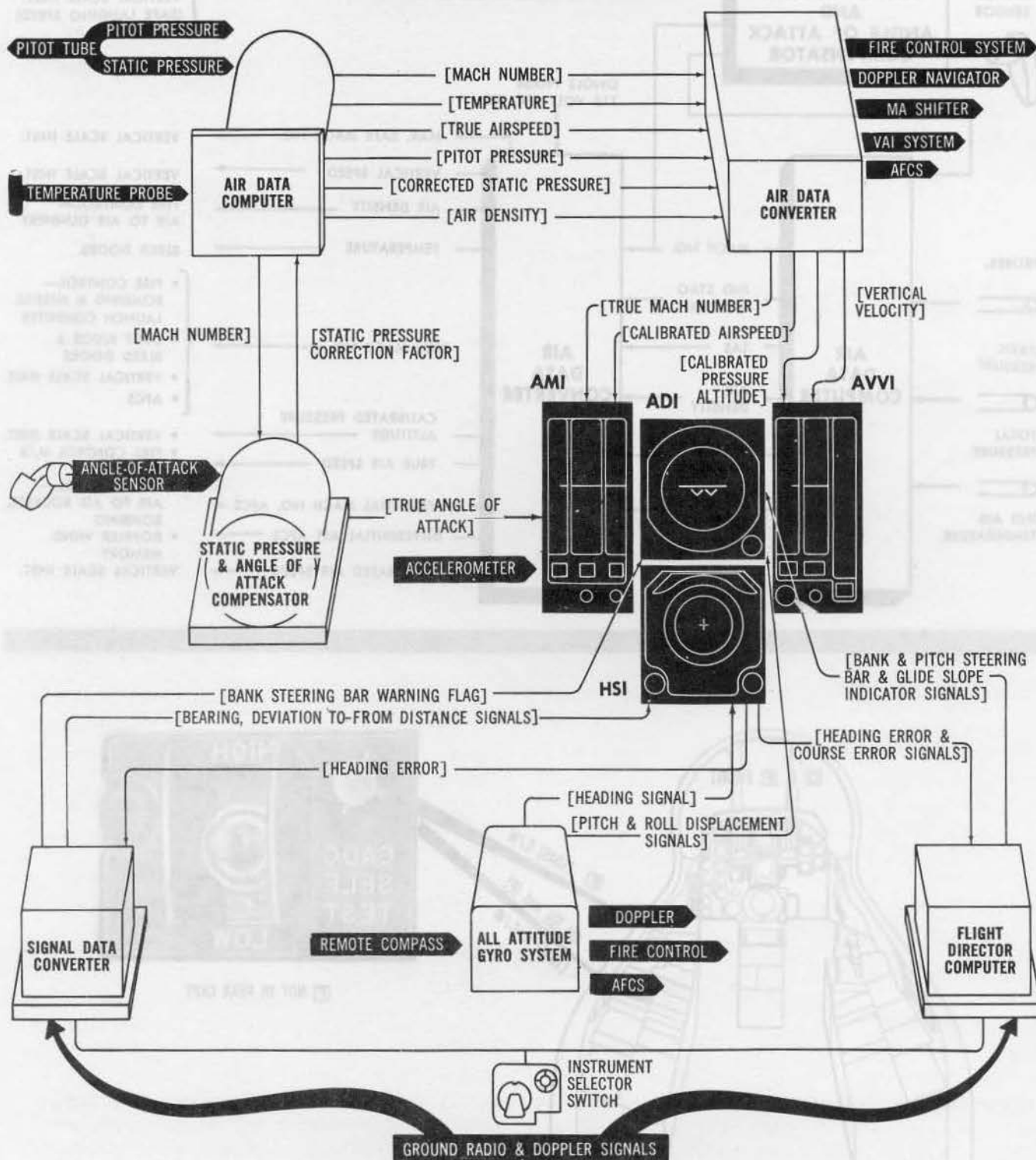


Figure 1-48

CADC (CENTRAL AIR DATA COMPUTER) SYSTEM

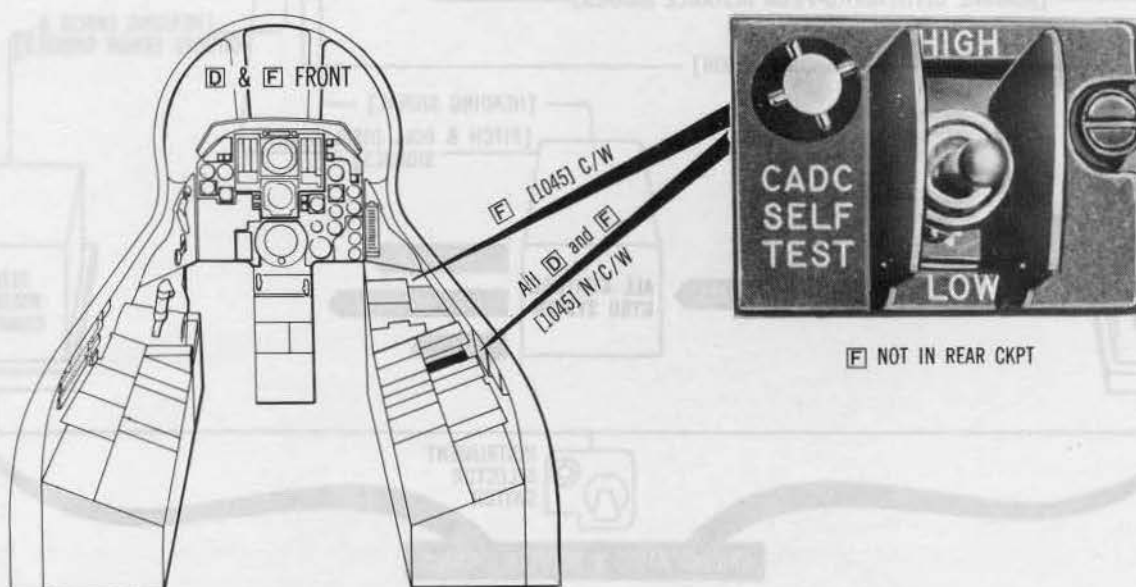
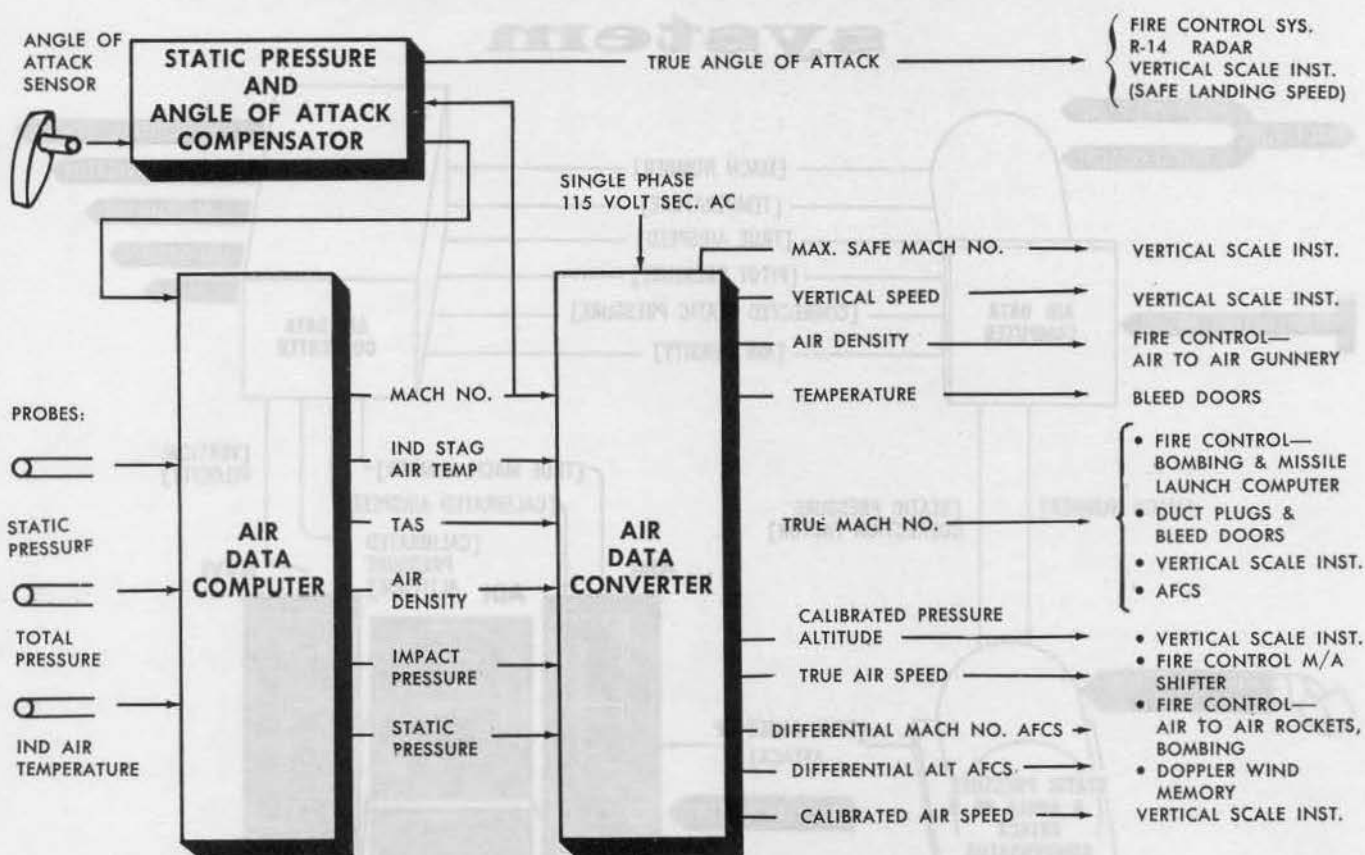


Figure 1-49

differentials which perform the necessary computations and transmits them as shaft rotations to the autosyn transmitters. The autosyn outputs provide electrical linkages between the computer and converter. The converter receives the corrected output signals of the computer, amplifies, organizes, and distributes them as potentiometer (linear) outputs to the respective aircraft system. The central air data computer system is powered by the single phase, AC secondary power.

Central Air Data Computer Test Switch (CADC).

The central air data computer test switch (figure 1-49) (not in rear cockpit) placarded CADC SELF TEST, and powered by AC secondary power, is a three-position spring-loaded to center type, with positions: HIGH, LOW, and an unmarked center position (OFF). The switch is used to make a preflight check by simulating (electrically) atmospheric inputs to the CADC system and observing the actions of the VAI, engine air bleed doors, pitch MA shifter and integrated flight instruments (AMI and AVVI). Other systems which use outputs of the CADC system (AFCS and fire control system) are also affected by actuation of the test switch but results cannot be observed during the preflight check. When the switch is held forward in the HIGH position, circuits are activated to produce a high altitude test problem in the air data computer as indicated by the vertical velocity indicator showing a rate of climb (rate unimportant). The computer will arrive at the test point after the switch is held in position for approximately 90 seconds and the indicators stabilize. In LOW position, the computer solves a low altitude test problem within 90 seconds. The complete CADC and VAI check is presented in section II as part of the preflight procedures. The action of the CADC system while making the CADC system check is not controlled and in no way resembles the action of the system under normal conditions. The computer is not designed to give the same response to an instantaneous change from 0 to 50, 740 feet altitude and from 0 to 519 knots airspeed (high test) as it does to conditions normally met in flight. The criteria for acceptance of the system should be whether or not the proper readings are obtained within one minute plus or minus 20 seconds after CADC switch actuation. If appropriate readings are not indicated on the vertical scale instruments when the HIGH or LOW test is made, a malfunction in the air data computer exists. All systems requiring electrical information from the air data computer system will be affected.

WARNING

Do not use the CADC test switch during flight. Systems affected by the test may cause control difficulties if the switch is inadvertently actuated in flight.

CADC and VAI Preflight Check.

Refer to section II for preflight check.

Angle of Attack Vane.

The angle of attack transmitter is mounted on the right side of the forward fuselage on the **F** and the left side of the forward fuselage on the **D** with the vane extending into the slip stream. The vane incorporates an anti-icing heating element powered by the AC secondary bus. The heater is controlled by the pitot heat switch. Changes in angle of attack result in rotation of the vane. The angle of attack transmitter provides signals used by the following:

- Angle of attack scale.
- Toss bomb computer.
- Terrain-avoidance radar mode.

WARNING

If the angle of attack vane is removed or damaged, the above mentioned systems or functions will be unreliable.

- F** • With the engine operating and the RAT (Ram Air Turbine) extended, systems dependent on angle of attack information such as the angle of attack scale on the AMI, are unreliable.

Airspeed-Mach Indicator (AMI).

The Airspeed-Mach Indicator (AMI) (figure 1-50) gives a vertical tape presentation of speed information. The AMI displays angle of attack indicator, accelerometer, Mach indicator and airspeed indicator.

AMI

(airspeed-mach indicator)

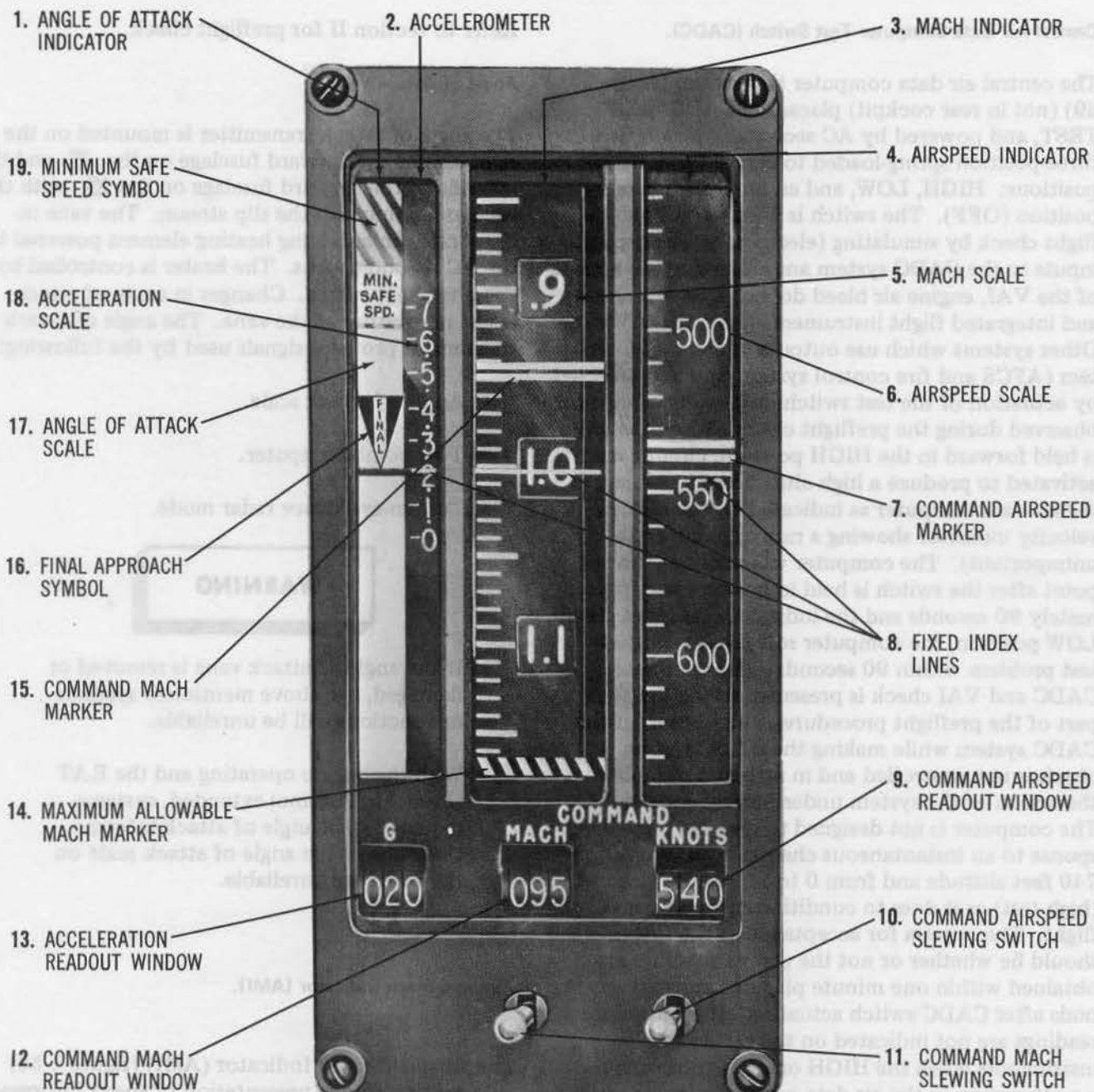
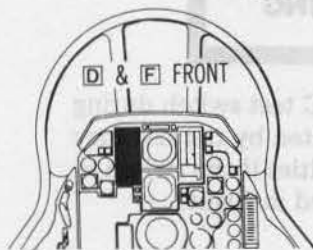


Figure 1-50

Note

The airspeed observed on the airspeed scale (6, figure 1-50) is calibrated. Normal sensing inputs (pitot and static pressure), are corrected in the air data computer system by mechanical cams and circuits for position error. The corrected electrical signal equivalents are then sent to the AMI. The Mach scale is corrected to read true Mach number.

Below the scales from left to right are an acceleration readout window, a command Mach readout window, and a command airspeed readout window. The indicator is remote reading and electrical signals for operation of the various scales and markers are supplied by the air data computer and the remote accelerometer. Power for operation of the tape motors and the servos is supplied by 115 volt AC secondary power through the AMI amplifier. Internal lighting for the indicator is powered by 115 volt AC primary power. In the event of AC power failure to the AMI, a spring-loaded airspeed warning flag marked OFF will appear across the airspeed scale.

Note

Although the airspeed warning flag appears only across the airspeed scale it indicates that all functions of the AMI are inoperative.

- If there is a signal failure from the air data computer, or accelerometer, the flag will not appear but the specific scale or marker operated by these signals will be inoperative.

Angle of Attack Indicator.

The angle of attack indicator (1, figure 1-50) located on the left side of the AMI provides safe speed information. A vertically moving tape displays a zero, a final approach symbol marked FINAL, and a diagonally striped minimum safe speed symbol marked MIN SAFE SPD. These symbols indicate safe speed as a function of angle of attack. When the aircraft is approaching the minimum safe speed range, as in a landing, the correct airspeed is controlled by maintaining a position of the final approach symbol with reference to the fixed index line. If airspeed becomes dangerously low and angle of attack reaches the minimum safe limit or stall, the striped warning

area (minimum safe speed symbol) will descend through the fixed index line. The pilot is aware of his approach to stall depending on the amount of the exposed clear portion of the moving tape between the fixed index line and the minimum safe speed marker. This is controlled by the pitch movement of the aircraft and airspeed. The angle of attack scale is positioned by electrical signals from the angle of attack transmitter and the air data computer system through the AMI amplifier.

Note

Angle of attack indications on the AMI are valid regardless of aircraft attitude (i.e.: crosswind, wing low turns with less than 1.0G, etc.).

Accelerometer.

The acceleration scale (18, figure 1-50) provides conventional G (load factor) information. The G forces being sustained by the aircraft are continuously shown by the acceleration scale read against a fixed index line. The scale is graduated from 0 to 7 Gs. There is no provision for indicating negative Gs. The reading on the acceleration scale is numerically shown in the acceleration readout window (18, figure 1-50). The acceleration scale and readout window are actuated by electrical signals from the remote accelerometer.

Mach Indicator.

The Mach scale (5, figure 1-50) in the center of the AMI indicates true Mach number on a moving scale as read against the fixed index line. The scale is calibrated in hundredths and shows numbers in tenths from 0.4 through 3.0. At speeds below Mach 0.4 the scale will continue to read 0.4. The scale is operated by electrical signals from the air data computer system. A double line command Mach marker (15, figure 1-50) and a command Mach readout window (12, figure 1-50) indicate manually selected command Mach.

Note

The double-line command Mach marker remains at the top or bottom of the display column until the selected command Mach comes into view on the Mach scale, at which time it will synchronize and move with the reading on the scale. The selected Mach is numerically displayed in the command Mach readout window at all times.

Command Mach setting is controlled manually by the command Mach slewing switch (11, figure 1-50) under the command Mach readout window. When manually selecting a command Mach number, slewing speed is proportional to the amount the slewing switch is displaced from its normal center position. The command system is capable of displaying speeds from Mach 0.4 through 2.2. The maximum safe Mach is indicated by a diagonally striped marker (14, figure 1-50) which normally rests at the bottom of the Mach scale. When maximum allowable Mach is approached the marker will climb toward the fixed index line. The maximum safe Mach has been reached when the marker is aligned with the fixed index. The maximum allowable Mach marker will show on the scale only in the Mach 1.0 to 3.0 range, depending on aircraft configuration, air density, and temperature. The maximum allowable Mach marker is operated by electrical signals from the air data computer system.

CAUTION

- Ⓚ On the airspeed Mach indicator the maximum allowable Mach marker is provided to indicate maximum allowable Mach as a function of altitude. This marker is not correct and should not be used to determine the maximum safe Mach.

Airspeed Indicator.

The airspeed scale (6, figure 1-50) on the right column of the AMI indicates calibrated airspeed on a scale read against a fixed index line. The scale is on a moving tape calibrated in 10 knot increments and displays numerals at each 50 knot interval from 50 through 1000 knots. At airspeeds below 50 knots the scale will continue to read 50. The airspeed scale is operated by electrical signals from the air data computer. A double line command airspeed marker (7, figure 1-50) and a command airspeed readout window (9, figure 1-50) below the scale indicate manually selected command airspeed. Command airspeed setting is controlled manually by the command airspeed slewing switch (10, figure 1-50) under the command airspeed readout window. When manually selecting a command airspeed, slewing speed is proportional to the amount the slewing switch is displaced up or down from the center position. Once the command airspeed is set into the command airspeed readout window, the double line command airspeed marker

remains at the top or bottom of the display column until the selected command airspeed comes into view on the airspeed scale, at which time it will synchronize and move with the reading on the scale. This will be the same reading as shown in the readout window.

Note

If the command airspeed slewing switch is moved to the detented position on the right, the command airspeed marker will align with the fixed index line and continuous presentation of the airspeed will then be displayed on the airspeed scale and in the readout window.

- Since the standby airspeed indicator position error and the tape airspeed scale cam correction vary with airspeed and altitude both systems must be corrected before their individual readings can be compared. An approximate comparison can be made when flying between 250 and 300 knots from sea level to 2000 feet altitude by adding the position correction of 10.5 knots to the standby indicator reading and the cam correction of 3 knots to the tape airspeed reading. The two corrected readings should then agree within the total system tolerances (± 5 knots standby plus ± 10 knots tape).
- ⓕ • An instrument failure simulator switch in the front cockpit allows the pilot to remove power from AMI, AVVI and ADI in the rear cockpit when solo, or to simulate an instrument system failure to check the rear pilot's ability to fly using standby instruments.

Altitude-Vertical Velocity Indicator (AVVI).

The altitude-vertical velocity indicator (AVVI) (figure 1-51) gives a vertical presentation of altitude and vertical velocity information. The indicator contains three main display columns. From left to right the columns are: the vertical velocity indicator, the altimeter scale and the gross, cabin and target altimeter. The target altitude marker is not operative.

Note

The altitude observed on the altitude scale is calibrated altitude. The air data computer system receives normal pitot and static inputs, and through a series

AVVI

(altitude vertical velocity indicator)

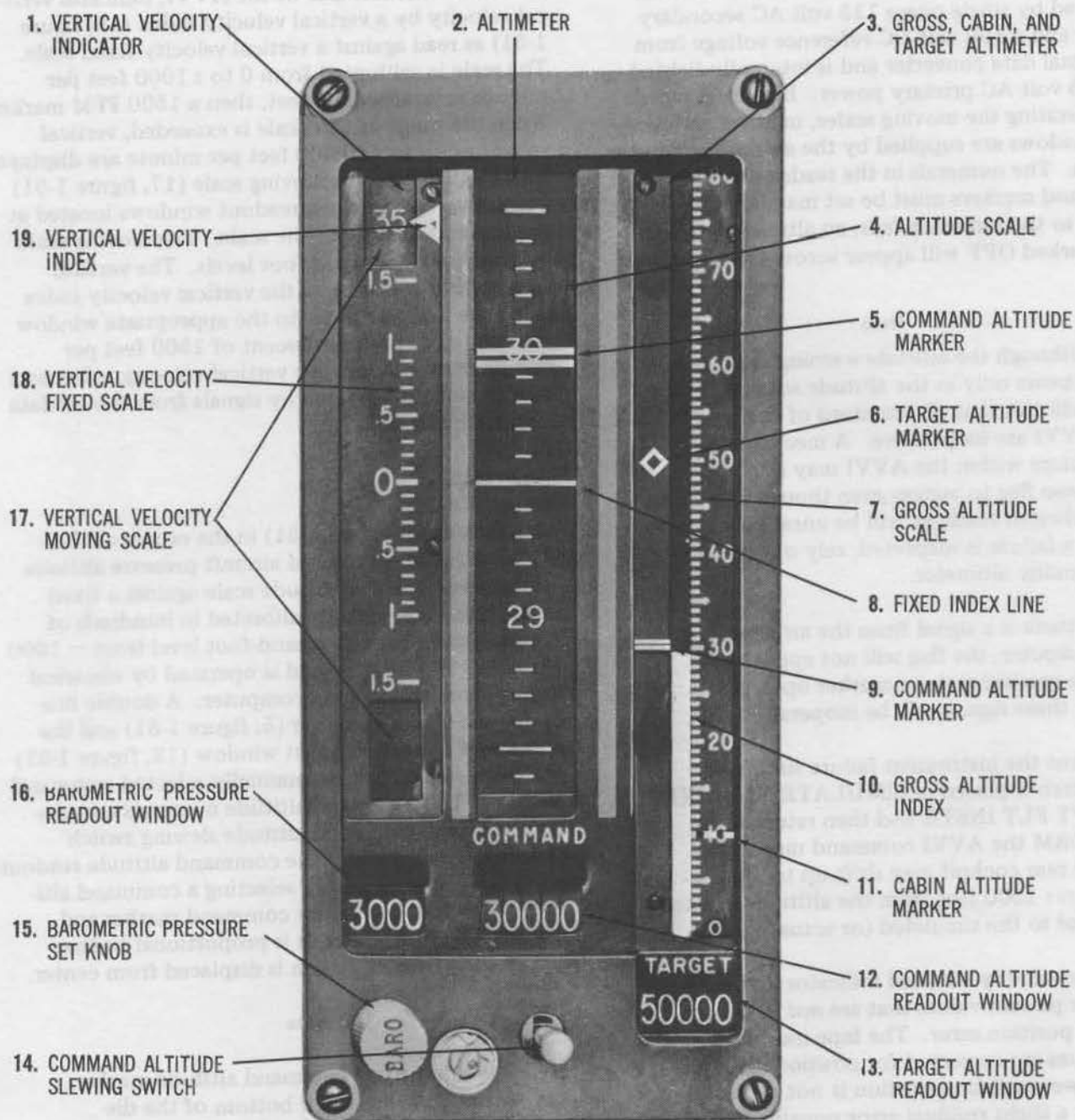
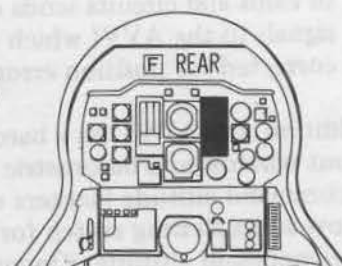
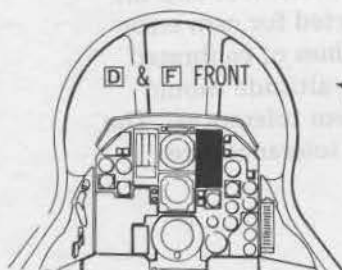


Figure 1-51

Note (Continued)

of cams and circuits sends electrical signals to the AVVI which have been corrected for position error.

In addition, the AVVI has a barometric pressure readout window and barometric pressure set knob, two command altitude markers with a single readout window and a slewing switch for manual selection of the command altitude, a target altitude marker with a readout window below the gross altitude scale, and a cabin altitude marker. The AVVI is powered by single phase 115 volt AC secondary power and a 100 volt DC reference voltage from the signal data converter and is internally lighted by 115 volt AC primary power. Electrical signals for operating the moving scales, markers and readout windows are supplied by the air data computer system. The numerals in the readout windows and command markers must be set manually. If AC power to the indicator fails, an altitude warning flag marked OFF will appear across the altitude scale.

Note

Although the altitude warning flag appears only in the altitude scale, it indicates that all functions of the AVVI are inoperative. A mechanical failure within the AVVI may not cause flag to appear even though the indicator readings will be unreliable. If a failure is suspected, rely on the standby altimeter.

- If there is a signal from the air data computer, the flag will not appear but the specific scale or marker operated by these signals will be inoperative.

Ⓔ • When the instrument failure simulator switch is placed in SIMULATE FAILURE AFT FLT INSTR and then returned to NORM the AVVI command markers in the rear cockpit may drift up to plus or minus 1000 feet from the altitude selected prior to the simulated (or actual) failure.

- The standby airspeed indicator and altimeter present values that are *not* corrected for position error. The tape indicator values are corrected for position error. However, this correction is not perfect and a slight residual error remains. This residual error is shown as a cam error in figure A1-3. When the standby values

are corrected for position error and the tape values are corrected for cam error the corresponding values of calibrated airspeed and pressure altitude should agree within the system tolerances. The tape airspeed system tolerances are ± 10 knots.

Vertical Velocity Indicator.

The vertical velocity fixed scale (18, figure 1-51) located on the left side of the AVVI, indicates vertical velocity by a vertical velocity index (19, figure 1-51) as read against a vertical velocity fixed scale. The scale is calibrated from 0 to ± 1000 feet per minute in hundreds of feet, then a 1500 FPM marker. When the range of this scale is exceeded, vertical velocities up to $\pm 40,000$ feet per minute are displayed on a vertical velocity moving scale (17, figure 1-51) and are viewed through readout windows located at the top and bottom of the scale. The moving scale displays only thousand foot levels. The vertical velocity index is used as the vertical velocity index reference and will move to the appropriate window when rate of climb or descent of 1500 feet per minute is exceeded. The vertical velocity index and moving scale is operated by signals from the air data computer system.

Altimeter.

The altitude (4, figure 1-51) in the center of the AVVI indicates calibrated aircraft pressure altitude which is read on the altitude scale against a fixed index line. The scale is calibrated in hundreds of feet, indicates each thousand-foot level from - 1000 through +80,000 feet, and is operated by electrical signals from the air data computer. A double line command altitude marker (5, figure 1-51) and the command altitude readout window (12, figure 1-51) below the scale indicate manually selected command altitude. The command altitude numerals are controlled by the command altitude slewing switch (14, figure 1-51) under the command altitude readout window. When manually selecting a command altitude, slewing speed of the command marker and readout window numerals is proportional to the amount the slewing switch is displaced from center.

Note

The double line command altitude marker remains at the top or bottom of the display column until the selected command altitude comes into view on the altitude scale, at which time it will synchronize and

Note (Continued)

move with the reading on the scale. The selected command altitude is numerically shown in hundreds in the command altitude readout window at all times.

- The last two digits in the readout window are fixed zeros. The scale can be set to a minimum of 100 and reads out in 100 foot increments.

Gross, Cabin, and Target Altimeter.

The gross, cabin, and target altimeter (3, figure 1-51) on the right side of the AVVI accumulates and displays all available altitude information on three different indicators or scales as follows:

1. A thermometer type gross altitude index (10, figure 1-51) shows aircraft altitude against a gross altitude scale (7, figure 1-51) and is operated by electrical signals from the air data computer. The gross altitude scale is calibrated in 1000 foot increments and numerically indicates 10,000 foot levels from 0 to 80,000 feet.
2. The cabin altitude marker (11, figure 1-51) is a moving striped marker read against the gross altitude scale. It is operated mechanically by a diaphragm element within the instrument case and has a range of from 0 to 50,000 feet.
3. The target altitude marker (6, figure 1-51) and the target altitude readout window (13, figure 1-51) are inoperative.

Command altitude is indicated by a double line command altitude marker (9, figure 1-51) and is simultaneously shown and operated in conjunction with the command altitude marker on the altimeter.

Barometric Pressure Set Knob, and Readout Window.

The barometric pressure reading is set by a knob marked BARO (15, figure 1-51) located on the lower left corner of the indicator, and is numerically displayed in the barometric pressure readout window (16, figure 1-51) above the knob. The knob is used to set current field barometric pressure into the AVVI.

Attitude Director Indicator (ADI).

The attitude director indicator (ADI) (figure 1-52) presents roll and pitch attitudes, rate of turn and

slip, computed bank and pitch steering information and glide slope displacement for instrument landing approaches. The indicator is remote reading and contains an amplifier powered by AC primary power which amplifies electrical pitch and roll signals from the all-attitude gyro system to operate the attitude sphere. The turn needle of the turn and slip indicator is operated by electrical signals directly from the rate gyro. The navigation and ILS bars, indicators and warning flags, operate independently of the ADI amplifier, and depending on the position of the instrument selector switch, receive electrical signals through the integrated flight instrument system flight director computer, from the ILS system, and through the integrated flight instrument system signal data converter from the Doppler system. The ADI is internally lighted from AC primary power. An attitude warning flag marked OFF, is located in the lower left corner of the indicator. Refer to the ADI TABLE for the bars, indicator, flags, etc., of the ADI which will or will not be operating when power to a component or a component failure occurs.

Attitude Presentation.

Attitude indications are presented by an attitude sphere (1, figure 1-52) a miniature aircraft (5, figure 1-52) a bank steering bar (4, figure 1-52) and a fixed outer ring with graduated markings. A horizon line is formed on the spherical dial by the meeting of a gray, upper climb section and a black, lower dive section. The attitude sphere operates and indicates through 360 degrees of roll and pitch and will not tumble even during extreme maneuvers. The sphere is remotely operated by electrical signals from the vertical gyro of the all attitude gyro system. Approximately 90 seconds after the application of AC primary power to the all attitude gyro system and to the indicator the sphere will erect and function normally; however, the attitude warning flag should move out of sight within approximately 60 seconds after application of power. The sphere operates at all times regardless of the position of the instrument selector switch.

WARNING

A small pitch error will appear as a slight pitch increase after acceleration and as a slight pitch decrease after deceleration.

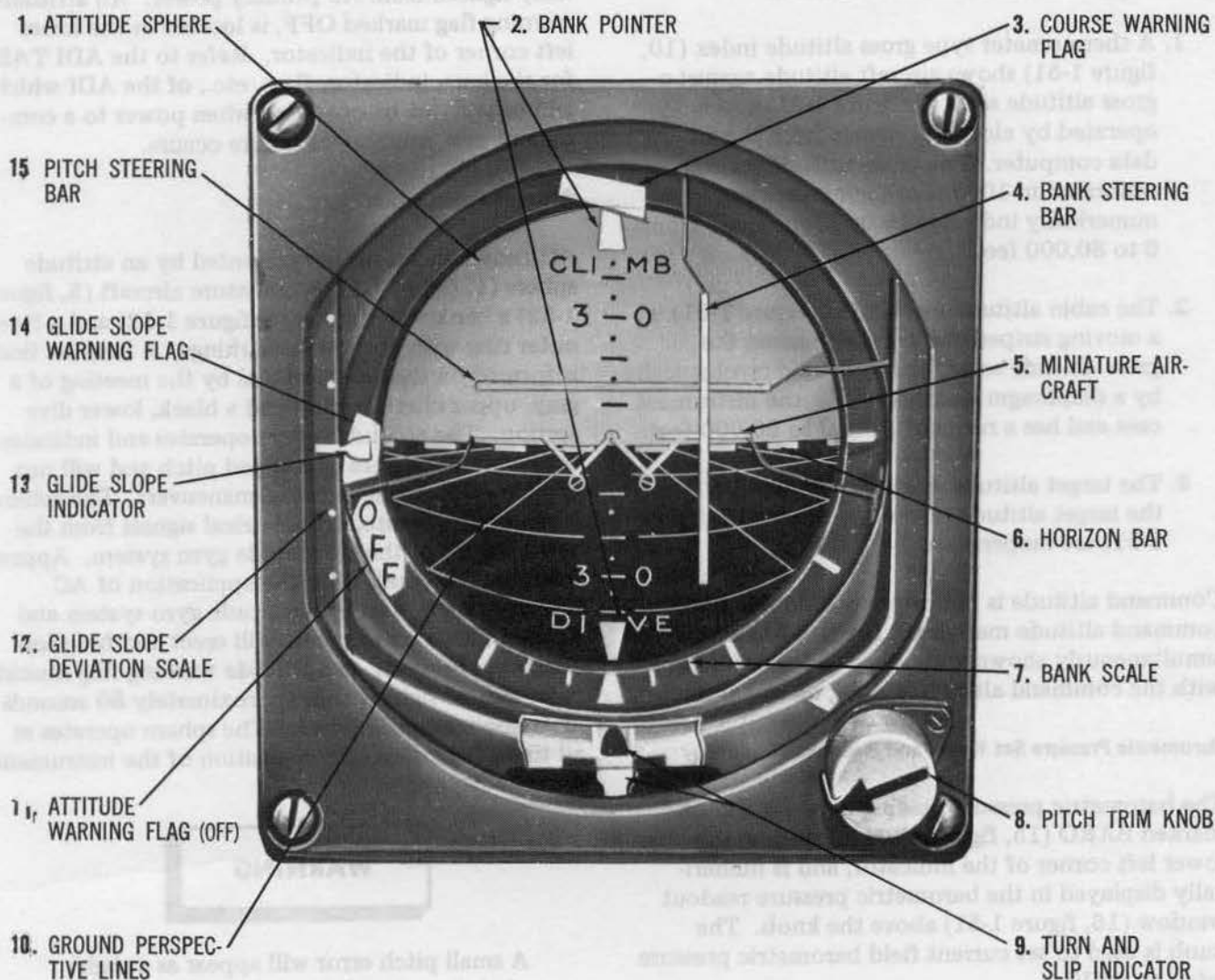
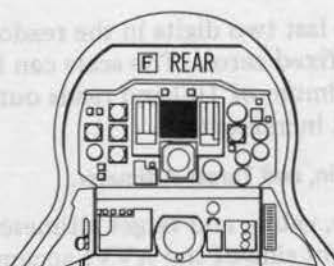
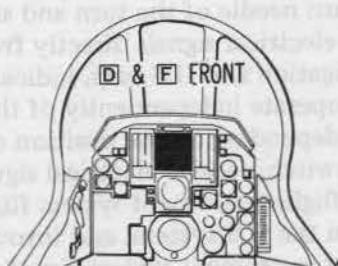
Note

If a start cycle is faulty (attitude sphere not erected after approximately 90 seconds)

ADI

(attitude director indicator)

(TYPE ARU-2B/A)



TYPE ARU-2A/A is physically the same as the ARU-2B/A, except that the steering bars are in back of the miniature aircraft instead of in front of it. This instrument when used with certain models of flight director computers, may not stow the PITCH STEERING BAR out of sight.

TYPE ARU-2/A is physically the same as the ARU-2A/A, except that the bank scale is at the top and the course warning flag at the bottom.

Figure 1-52

ADI TABLE

O Operating I Inoperative *Provided the associated systems are ON, and the instrument selector switch is in the proper position.								
Type of Failure	Attitude Sphere	Attitude Warning Flag	Turn Indicator	Bank Steering Bar	Course Warning Flag	Pitch Steering Bar	Glide Slope Ind.	Glide Slope Warning Flag
DC primary	O	Out of View	I	O*	Out of View*	O*	O*	Out of View*
AC secondary (AC GEN Light Illuminated)	O	Out of View	O	I	I	I	I	In view
Power to or in the all Attitude Compass Sys.	I	In View	O	O*	Out of View*	O*	O*	Out of View*
Power to or in the ADI amplifier	I	In View	O	O*	Out of View*	O*	O	Out of View*

Note (Continued)

the fast erection button may be depressed to erect the attitude sphere.

After accelerations or decelerations the vertical gyro can be fast erected to cancel out the acceleration errors, by depressing the vertical gyro fast erection button. When the pitch steering bar has centered within four bar widths on the ADI, the gyro can be considered fully erect, and the button must be released. Depressing the button momentarily to check erection is permissible.

CAUTION

The vertical gyro fast erection button should not be used unless the acceleration errors are in excess of one degree. Fast erection should only be used in wings level unaccelerated flight. Continuous operation of the fast erection button is limited to 30 seconds followed by a 90 second cooling period to prevent damage to the slewing motors and the electrolytic erection switches.

- While the vertical gyro fast erection button is held depressed, the attitude warning flag on the ADI will appear, however, attitude information is reliable.

Since level flight pitch attitudes vary with different loadings and speeds, a pitch trim knob (8, figure 1-52) is provided on the indicator to adjust the attitude sphere when in level flight.

WARNING

It is mandatory to cross check the aircraft's roll attitude indication with the turn indicator and standby attitude indicator at all times, especially during rapid descents. If bank indications do not follow aircraft motion as shown on the slip indicator, this indicates a malfunction has occurred in the roll circuitry. Accurate pitch attitude information may still be displayed on the ADI. Due to possible leakage in the gyro case of the all-attitude gyro system it is possible for the gyro case to collapse and bind the vertical gyro outer gimbal when descending to lower altitudes. This will show up as a fixed roll indication on the ADI sphere regardless of aircraft attitude, and does affect bank steering information, and the bank steering bar is not reliable.

Turn and Slip Indicator.

A conventional turn and slip indicator (9, figure 1-52) are located on the indicator below the attitude sphere. The turn indicator operates at all times and receives electrical signals from the rate gyro and is dependent upon DC primary power for operation. When the indicator is deflected one needle width it indicates a (90 degree per minute) four-minute turn. The slip indicator, which operates as a function of

gravity and centrifugal force, functions at all times and needs no electrical power for operation.

Bank Steering Presentation.

Computed bank steering information in relation to a desired heading, target, or destination, and computed steering information (with the instrument selector switch in ILS and the steering bar (needle) switch ON) indicating direction of bank necessary to intercept and maintain a localizer beam, is presented by the bank steering bar (4, figure 1-52). Signals for operating the bar are supplied by the flight director computer which receives signals from the all attitude gyro system, the HSI, the Doppler navigator, and the ILS radio for modification and distribution to the integrated flight instrument system. Depending on the instrument mode selected, keeping the bar centered indicates the aircraft is flying a correct intercept, or is on the desired heading, localizer beam, or Doppler course. If the bar is off center, the aircraft must always be banked towards the bar to center the bar to make good the desired heading, or course. With the instrument selector switch in the ILS-LCL position, the bank steering bar automatically provides up to a 45 degree intercept of the localizer beam with an asymptotic rollout as the beam is approached. The bank angle is limited to approximately 35 degrees in the LCL mode. When the instrument selector switch is in the ILS-FINAL position, a correction is provided for drift in the computed signal on the bank steering bar and the correct crab angle is attained when the bar is centered. The bank angle is limited to 15 degrees in the ILS FINAL mode. The ILS-FINAL position should not be selected until the aircraft is inbound and on the localizer beam. When the instrument selector switch is at MAN, the bank steering bar is in view and will indicate desired heading or correct intercept approach to a manually selected heading on the HSI. During fire control functions (depression of the freeze/fire button prior to a toss bomb maneuver) the bank steering bar is used as a roll reference. When the bar is centered the wings are level. A steering bar (needle) switch (24, figure 1-3) is used to control the operation of the bar. When in the ON position the bar will operate. When in the OFF position all signals are removed and the bar moves out of sight. However, regardless of the position of the steering bar (needle) switch, or the instrument selector switch, (except ILS-LCL or ILS-FINAL) when the freeze/fire button is depressed all signals are removed, and the bank steering bar displays only roll information. In the  when flying dual, the steering bar

(needle) switch is only operable in the cockpit with control of the FLIGHT take-over system. A red course warning flag will appear at the top or bottom of the indicator (depending on indicator type) when the bank steering bar is receiving no signals or signals are too weak or unreliable, from ILS, or Doppler receivers.

Note

With the steering bar (needle) switch OFF, if the instrument selector switch is moved past ILS-OUTBND to ILS-LCL or ILS-FINAL and then returned to ILS-OUTBND, the bank steering bar will appear. To drive the steering bar out of view place the steering bar (needle) switch ON then OFF.

Glide Slope Presentation.

The glide slope indicator presents the position of the glide slope beam in relation to the aircraft for an instrument landing approach. Full deflection of the indicator from center is one-half degree. The glide slope indicator is operated by electrical signals from the AN/ARN-61, ILS radio receiver and is out of view unless the steering bar (needle) switch is ON and the instrument selector switch is at ILS-LCL or ILS-FINAL position. When the indicator is aligned with the index the aircraft is on the glide slope. Refer to AN/ARN-61 Radio Receiver Set in this section for application. The pitch steering bar (15, figure 1-52) presents computed pitch steering information indicating direction of flight to intercept and maintain the glide slope beam. The bar is operated by electrical signals from the vertical gyro of the all attitude gyro system and the AN/ARN-61 radio through the flight director computer. The pitch steering bar is out of view unless the steering bar (needle) switch is ON and the instrument selector switch is at ILS-FINAL. When the bar is centered the attitude of the aircraft for capture of the center of the glide slope beam is correct or the aircraft is on glide slope. When the bar is not centered always move the aircraft towards the bar to center it.

WARNING

When the steering bar (needle) switch is placed OFF, the glide slope pointer will remain stowed, regardless of instrument mode selected.

Warning (Continued)

- Some aircraft are presently equipped with a combination of flight director computer and ADI which displays the pitch steering bar at all times. Any indications that the pitch steering bar displays, except in ILS FINAL position of the instrument selector switch, are to be disregarded. In ILS FINAL position the pitch steering bar supplies correct information.

Steering Bar (Needle) Switch.

The steering bar (needle) switch (24, figure 1-3) is a two-position switch placarded STEER NEEDLE, with positions marked ON and OFF. The switch controls power and signals to the pitch and bank steering bars, the glide slope indicator, and glide slope warning flag of the ADI in each cockpit. In the **F** when flying dual the switch is operable only in the cockpit with the FLIGHT take-over button engaged. When the switch is OFF the pitch steering bar, bank steering bar, glide slope indicator, and glide slope warning flags are out of view.

Note

With the steering bar (needle) switch OFF, the bank steering bar will appear if the instrument selector switch is rotated through ILS-OUTBND to another ILS position and then returned to ILS-OUTBND. The bar can be driven from view by cycling the steering bar (needle) switch to ON and back to OFF.

When the switch is ON the bank steering bar is in view regardless of the instrument selector switch position. The pitch steering bar is out of view in all instrument selector positions except ILS-FINAL. In the ILS-OUTBND and TAC modes, actuation of the vertical gyro fast erect button will cause the pitch steering bar to appear. When flying straight and level with the Bomb/Nav switch at BOMB, the pitch steering bar will move toward center during fast erection. Full gyro erection is indicated when the bar is centered to within four bar widths of the miniature aircraft symbol. With the steering switch ON the glide slope indicator is out of view except during the ILS-FINAL or LCL modes and the glide slope warning flag is out of view at all times, and appears only if ILS signals are weak or unreliable in the ILS-FINAL or LCL modes.

Power and Signal Failure Indicators.

If power fails in the all attitude gyro system, the ADI, or the vertical gyro fast erection button is depressed a red attitude warning flag (11, figure 1-52) marked OFF will appear on the left lower side of the indicator. Whenever electrical signals from the selected navigational receiver (instrument selector switch at DOPPLER, ILS-LCL or ILS-FINAL) are weak or unreliable for operation of the bank steering bar, or a secondary AC power failure occurs, the red course warning flag (3, figure 1-52) will appear on the face of the indicator.

If signals from the ILS glide slope receiver are inadequate for operation of the glide slope indicator or a secondary AC power failure occurs, a red glide slope warning flag (14, figure 1-52) will appear at left side of indicator. If the steering bar (needle) switch is OFF, the glide slope warning flag will be in view regardless of the instrument mode selected.

Horizontal Situation Indicator (HSI).

The horizontal situation indicator (HSI) (figure 1-53), visually displays a plan view of navigation and attack positioning information. Depending on the instrument selector switch position, the HSI will present the following information: mode lights to indicate the mode of operation; magnetic heading provided from the all-attitude compass system; bearing information provided from a remote source in all but the manual mode of operation; command heading information provided from a remote source or set manually; course information provided from a remote source or set manually; displacement of the aircraft from a selected course; to-from indication from a selected TACAN station; numerical indication of distance to a TACAN station, a target, or destination. Electrical signals for operation of the pointers, arrows and indicators are supplied by the Doppler, ILS, and TACAN systems through the integrated flight instrument system signal data converter which modifies and converts these signals to supply standardized inputs to the HSI. The signal data converter is powered by AC secondary power and, in the event of failure, will affect the systems above. Signals for operation of the compass card come directly from the compass system through an HSI amplifier. The HSI contains its own amplifier and associated power supplies. The HSI amplifiers for the compass card, bearing pointer and course deviation scale are powered by AC primary power.

The HSI amplifier for the heading marker and course arrow is powered by AC secondary power. The range indicator, and to-from indicator require no amplification and receive signals directly from the TACAN set through the signal data converter. Refer to the HSI table for HSI components that are operative or inoperative in the event of AC primary or AC secondary power failure (AC GEN indicator light illuminated).

Aircraft Heading.

The aircraft's magnetic heading is displayed on a compass card (17, figure 1-53) and is read under the upper lubber line 3, (figure 1-53) located at 12 o'clock position on the indicator face. Reciprocal heading is read under the lower lubber line at the 6 o'clock position. The compass card is operated remotely by signals from the directional gyro of the all attitude gyro system. With the function selector knob on the compass controller in the SLAVED position existing heading of the aircraft is displayed within approximately 90 seconds after the application of AC primary power to the system (depending on position of the compass card to actual aircraft heading). The compass card functions at all times regardless of the instrument selector switch position.

Command Heading.

A double line heading marker (1, figure 1-53) which can rotate around the outer edge of the compass

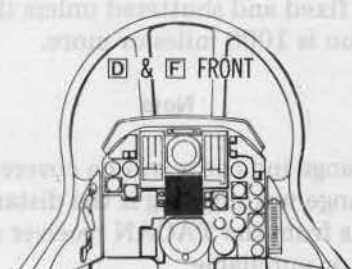
card indicates remotely or manually selected command heading. With the instrument selector switch in MAN, TAC or any of the ILS sub-positions, the heading marker can be set manually by the pilot using the heading set knob (13, figure 1-53). Once the marker is set it will synchronize and rotate with the compass card. With the instrument selector switch in DOPPLER the heading marker is automatically positioned. If the marker is remotely driven by Doppler signals, movement of the heading set knob will have no effect on the heading marker position. When manually setting the marker, clockwise rotation of the heading set knob moves the marker clockwise.

Course Presentation.

A desired course or track is displayed by a course arrow (2, figure 1-53) which rotates within the compass card, and is remotely driven by electrical signals from the Doppler navigator, or manually set by the course set knob (9, figure 1-53). If the course arrow is being positioned remotely by Doppler signals, movement of the course set knob will have no effect on the arrow. Once the arrow is set it will synchronize and rotate with the compass card. Clockwise rotation of the course set knob moves the arrow clockwise around the indicator. With the instrument selector switch at MAN, the course arrow becomes fixed with the lubber line, and the course selector window (10, figure 1-53) will then numerically indicate the aircraft heading. In the TAC and ILS positions the arrow can be manually set to a desired

HSI TABLE								
O DISPLAY IS OPERATIVE			I DISPLAY IS INOPERATIVE				*Can be manually set.	
<i>Electrical Failure</i>	<i>Compass Card</i>	<i>Heading Marker</i>	<i>Bearing Pointer</i>	<i>Deviation Course</i>	<i>Course Arrow</i>	<i>Course Selector Window</i>	<i>Range Indicator</i>	<i>To-From Indicator</i>
AC PRI	I	O	I	I	O	O	O	O
AC SEC.	O	I*	I	I	I*	I	I	I
Note Failure of the Doppler navigator or CIN power supply will affect the displays. Refer to the CIN MAIN POWER SUPPLY CAUTION LIGHT and the individual systems in this section for system affected.								

HSI (horizontal situation indicator)



NOTE: Situation shown is with the instrument selector at TAC and the TACAN function selector at T/R.

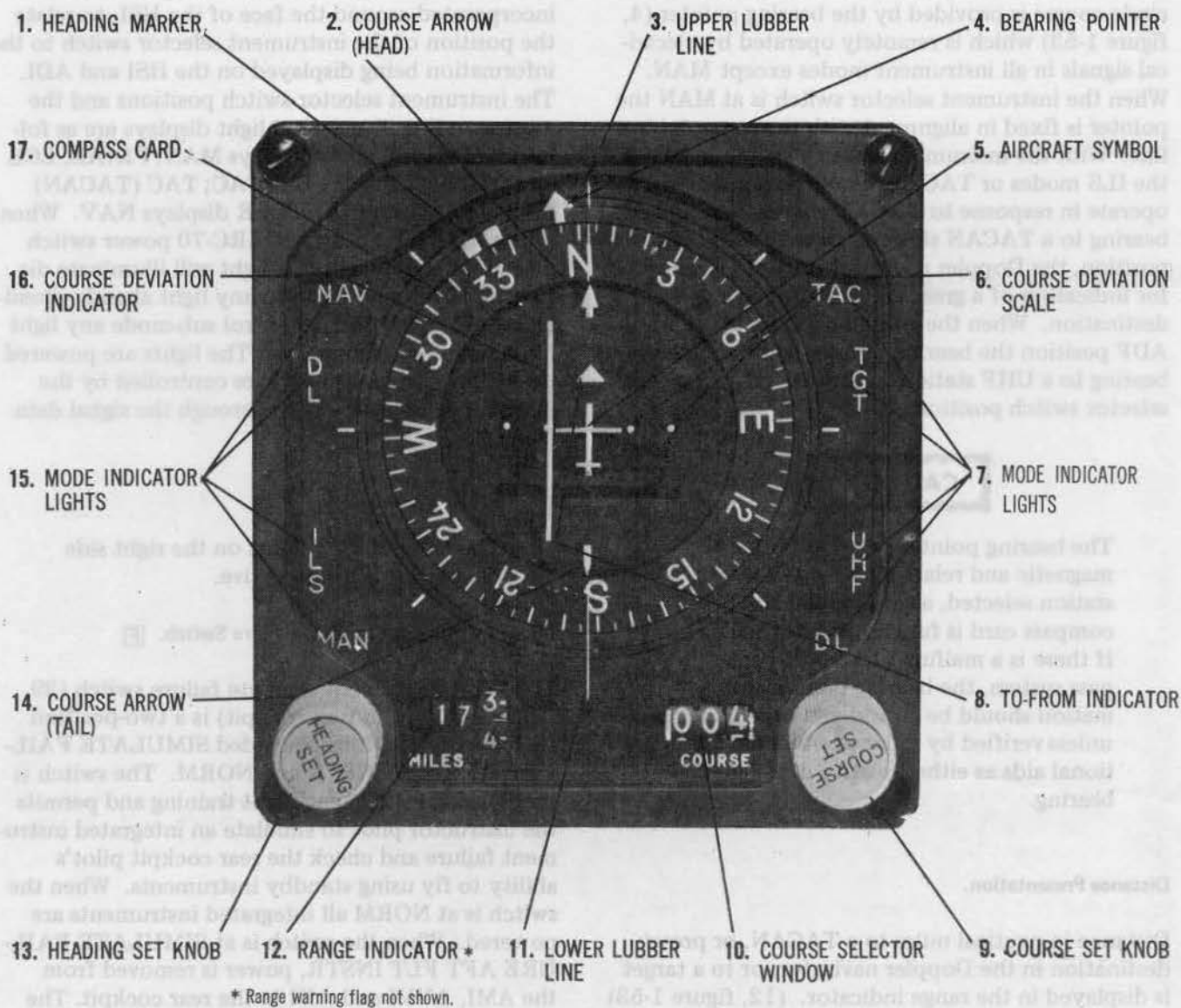
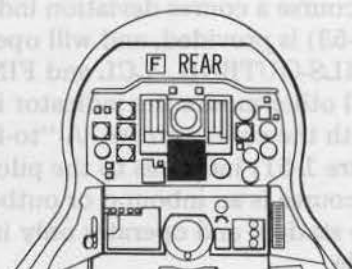


Figure 1-53

course. In the DOPPLER position the arrow indicates the magnetic ground track. The magnetic position of the course arrow is numerically shown in the course selector window of the indicator. To indicate the position of the aircraft in relation to the selected course a course deviation indicator (16, figure 1-53) is provided, and will operate in the TAC, or ILS-OUTBND, -LCL and FINAL modes. In all other modes the indicator is fixed in alignment with the course arrow. A "to-from" indicator (8, figure 1-51) indicates to the pilot whether the selected course is an inbound or outbound course course to the station, and operates only in the TACAN mode.

Bearing Presentation.

Indication of bearing to a station, target, or a great circle course is provided by the bearing pointer (4, figure 1-53) which is remotely operated by electrical signals in all instrument modes except MAN. When the instrument selector switch is at MAN the pointer is fixed in alignment with the upper lubber line. With the instrument selector switch in any of the ILS modes or TAC position, the pointer will operate in response to TACAN signals, and indicate bearing to a TACAN station. In the DOPPLER position, the Doppler navigator provides signals for indication of a great circle course to a preset destination. When the command radio set is in the ADF position the bearing pointer will indicate the bearing to a UHF station (regardless of instrument selector switch position).

CAUTION

The bearing pointer presents both magnetic and relative bearing to the station selected, as long as the HSI compass card is functioning normally. If there is a malfunction in the compass system, the bearing pointer information should be considered unreliable unless verified by radar or other navigational aids as either relative or magnetic bearing.

Distance Presentation.

Distance in nautical miles to a TACAN, or preset destination in the Doppler navigator, or to a target is displayed in the range indicator. (12, figure 1-53) on the lower left side of the indicator. Distance information for the appropriate display is only

shown in the indicator when the instrument selector switch is in the corresponding position. In the MAN mode or the ADF sub-mode the range indicator is covered by the range warning flag. The numerals can display from 1999 to 000 miles. The thousand numeral is fixed and shuttered unless the distance to a destination is 1000 miles or more.

Note

The range indicator will be covered by the range warning flag if the distance signals from the TACAN receiver are weak or unreliable.

Mode Indicator Lights.

Mode indicator lights (7 and 15), figure 1-53 are incorporated around the face of the HSI, to relate the position of the instrument selector switch to the information being displayed on the HSI and ADI. The instrument selector switch positions and the corresponding illuminated light displays are as follows: MAN (manual) displays MAN; FINAL, LCL and OUTBND display ILS/TAC; TAC (TACAN) displays TAC; and DOPPLER displays NAV. When in the ADF submode (AN/ARC-70 power switch placed in ADF position) a light will illuminate displaying UHF in addition to any light already illuminated. When in the fire control sub-mode any light illuminated will remain on. The lights are powered by AC primary power and are controlled by the instrument selector switch through the signal data converter.

Note

The DL and TGT lights on the right side of the HSI are inoperative.

Flight Instrument Simulate Failure Switch. [E]

The flight instrument simulate failure switch (29, figure 1-7) (not in rear cockpit) is a two-position switch with positions placarded SIMULATE FAILURE AFT FLT INSTR and NORM. The switch is used during instrument flight training and permits the instructor pilot to simulate an integrated instrument failure and check the rear cockpit pilot's ability to fly using standby instruments. When the switch is at NORM all integrated instruments are powered. When the switch is at SIMULATE FAILURE AFT FLT INSTR, power is removed from the AMI, AVVI and ADI in the rear cockpit. The switch controls AC power to the above mentioned instruments.

Note

- [F] When power has been removed from the rear cockpit integrated instruments and then reapplied, the AVVI command markers may drift up to ± 1000 feet from the altitude selected prior to the simulated or actual failure.

ALL ATTITUDE COMPASS SYSTEM.

The all-attitude compass system is a central master gyro reference system that provides for movement and indication of 360 degrees in the roll, pitch, and yaw axes. The gyro platform contains a vertical and directional gyro. The directional gyro is tied in with the remote compass transmitter and amplifier to provide a gyro stabilized compass system. Electrical signals proportional to pitch, roll and heading changes sensed at the gyro axes are sent to the various aircraft systems. Pitch and roll signals from the vertical gyro operate the sphere of the ADI. These signals are also sent to the flight director computer, and are mixed with heading, Doppler, or ILS signals for operation of the bank steering bar of the ADI. Heading signals from the directional gyro operate the compass card of the HSI and are also mixed in the flight director computer with crosswind signals, and course and radio approach rate signals, for operation of the bank steering bar of the ADI. In addition to the tie-in with the integrated instrument system, the all-attitude gyro system supplies information to the Doppler navigator, AFCS and fire control. The all-attitude gyro system is powered by DC and AC primary power.

FLIGHT DIRECTOR COMPUTER.

The flight director computer section of the IFIS accepts standard guidance, attitude and heading information, and processes this information for presentation as bank and pitch steering information, and warning flags on the ADI. The computer receives signals from the all-attitude gyro system, the ILS receiver, the signal data converter and the HSI. Displacement and rate signals are computed in such a manner to provide asymptotic approach to a desired flight path or heading and steering information for easily maintaining the desired flight path. The computer contains mode switching relays, which are actuated by the instrument selector (figure 1-55) on the main instrument panel. The flight director computer is powered by 115 volt AC secondary power.

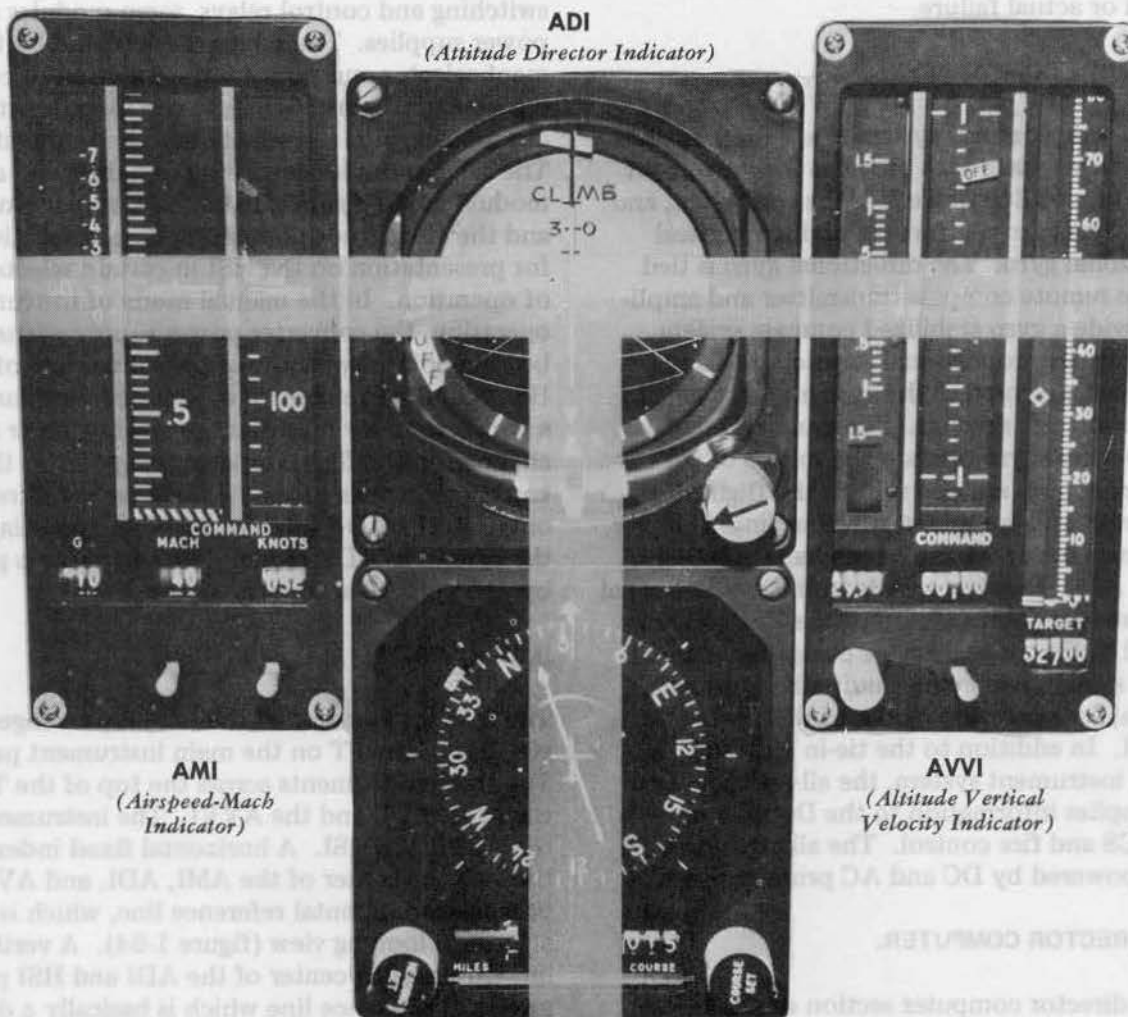
SIGNAL DATA CONVERTER.

The signal data converter section of the IFIS accepts signals from various systems in the aircraft, and switches, modifies or converts these signals as required to supply standardized signals to the integrated instrument display. The converter contains mode switching and control relays, servo modules and power supplies. The relays are actuated by the instrument selector and perform the function of connecting the appropriate signals to the instruments in accordance with the selected mode of operation. The servo modules consisting of a drift and a heading module modify signals from the Doppler navigator and the all-attitude compass system respectively, for presentation on the HSI in certain selected modes of operation. In the manual mode of instrument operation, the converter power supply aligns the bearing pointer with the upper lubber line of the HSI. On the fire control sub-mode (see figure 1-55), a converter relay modifies the heading error and roll channels in the flight director computer so that the bank steering bar of the ADI indicates roll reference only. In the ADF sub-mode a converter relay places the system in ADF mode. The converter is powered by 115 volt AC secondary power.

INSTRUMENTS.

The four instruments of the IFIS are arranged in a group to form a T on the main instrument panel. The three instruments across the top of the T are the AMI, ADI, and the AVVI. The instrument below the ADI is the HSI. A horizontal fixed index line through the center of the AMI, ADI, and AVVI provides a horizontal reference line, which is basically a forward looking view (figure 1-54). A vertical fixed line through the center of the ADI and HSI provides a vertical reference line which is basically a downward looking view. Indicators and pointers are grouped about the horizontal and vertical reference lines to indicate the necessary control movement (stick, rudder, or throttle) to bring the desired heading, course, altitude, airspeed, Gs, etc., in alignment with the fixed horizontal or vertical reference lines. The moving scales, pointers, bars, indicators, and compass card of the integrated instrument display function so that a corresponding control movement is required to fly the aircraft toward a selected heading, attitude, airspeed, station or destination, when it is shown displaced from the vertical or horizontal fixed reference lines. Increased airspeed or Mach, and decreased altitude, Gs or angle of attack (which are shown below the fixed horizontal index),

INTEGRATED FLIGHT INSTRUMENT display



The integrated instruments are grouped on the main instrument panel to form a tee. A horizontal reference line through the top three instruments represents the forward looking view. A vertical reference line through the ADI and HSI represents the downward look (or plan) view.

HSI
(Horizontal Situation Indicator)

NOTE

- The display in the forward looking view, along the horizontal reference line, is governed by fore and aft movements of the stick and/or throttle, and include pitch, airspeed, Mach number, vertical velocity, altitude, angle of attack and acceleration.
- The downward looking display is controlled by motions of the stick sideways and include heading, bank, turn rate, and navigational as well as tactical information.
- By scanning the horizontal or vertical reference lines, it is possible to determine as indicated by the command marker and other indicators whether or not the aircraft's performance, in relation to airspeed, altitude, and course, differs from the desired performance.

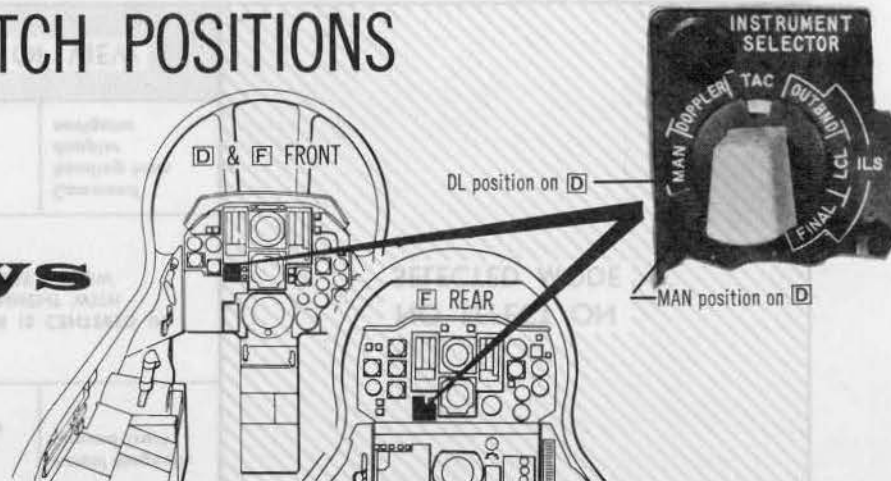
Figure 1-54

INSTRUMENT SELECTOR SWITCH POSITIONS

and displays

notes:

1. ADF submode goes into effect when AN/ARC-70 function control switch is placed in ADF position.
2. Fire control submode goes into effect when the freeze fire button is depressed.



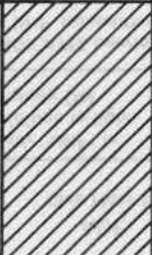
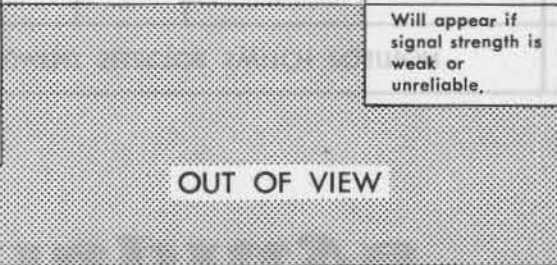
	INSTRUMENT SELECTOR SWITCH POSITION						SUB MODES			
ADI (ATTITUDE DIRECTOR INDICATOR)	ILS			TAC	MAN (MANUAL)	DOPPLER	ADF (See Note 1)	FIRE CONTROL (See Note 2)	STEERING BAR SWITCH	
	FINAL	LOCALIZER	OUTBD						ON	OFF
Bank steering bar (steering information)	Steers to intercept and capture localizer. Center bar to make good the localizer			Steers to manually selected heading		Doppler heading		When freeze fire button is depressed, removes all selected displays and substitutes fire control output for roll reference, regardless of steering bar switch position.		The bar is driven out of view except when in the fire control submode.
Course warning Flag.	Will appear if signal strength entering the equipment is weak and/or unreliable.					Will appear if signal strength is weak or unreliable.				
Glide slope indicator	INDICATES GLIDE SLOPE DEVIATION									
Glide slope warning Flag.	Will appear if signal strength is weak and/or unreliable.									
Pitch steering bar	Information to intercept glide slope. Center bar to make good the glide slope			(ON THE ARU 2/A INSTRUMENT — REMAINS IN VIEW AND STOWS ON THE LOWER SECTION)						

Figure 1-55 (Sheet 1 of 2)

INSTRUMENT SELECTOR SWITCH POSITIONS and displays

	INSTRUMENT SELECTOR SWITCH POSITION						SUB MODES			
HSI HORIZONTAL SITUATION INDICATOR	ILS			TAC	MAN (MANUAL)	DOPPLER	ADF (See Note 1)	FIRE CONTROL (See Note 2)	STEERING BAR SWITCH	
	FINAL	LOCALIZER	OUTB'D						ON	OFF
Mode Indicator lights	ILS/TAC	ILS/TAC	ILS/TAC	TAC	MAN	NAV	Adds "UHF" in addition to lights already ON			
bearing pointer	INDICATES BEARING TO A TACAN STATION TACAN Set – ON			Pointer becomes fixed and aligned with top of lubber line	Indicates great circle course to a destination	INDICATES bearing to UHF transmitter				
Range indicator	INDICATES DISTANCE IN NAUTICAL MILES TO A TACAN STATION			Shuttered	Indicates distance in nautical miles to a destination	Shuttered				
Course Arrow and Course Selector window	Runway course must be manually set			Tacan radial manually set.	Arrow be- comes fixed at lubber line. Window reads out heading.	Actual Magnetic Ground Track				
Course Deviation Indicator	INDICATES DEVIATION FROM TRANSMITTED ILS COURSE			Indicates Deviation From a selected TACAN heading	INDICATOR IS CENTERED IN ALIGNMENT WITH COURSE ARROW					
Heading Marker	ANY DESIRED HEADING-MANUALLY SET				Command heading from doppler navigator					
TO-FROM Indicator	OUT OF VIEW		Indicates "TO" or "FROM"	OUT OF VIEW						

Figure 1-55 (Sheet 2 of 2)

all require forward stick or throttle movement. With the glide slope indicator or pitch steering bar above the horizontal reference line, aft stick movement is required to center the indicator and bar, and vice versa. Increased heading, course deviation, or the bank steering bar to the right of the vertical reference line requires a right bank.

Integrated Flight Instrument Presentations.

Basic Flight Instruments. In the center of the four instrument display, because of its importance, is the ADI which displays the following flight information: Completely unrestricted attitude information in both pitch and roll; turn rate; and slip. To the left of the ADI is the AMI which displays the following flight information in reference to the fixed index lines: angle of attack; normal acceleration (Gs); true Mach; and calibrated airspeed. To the right of the ADI is the AVVI which displays the following information: vertical velocity; calibrated pressure altitude; and gross, cabin and target altitude (entire scale is visible). Below the ADI is the HSI which presents a magnetic or instrument heading.

Navigation Instruments. The navigation instruments of the IFIS are the ADI, and HSI which complement the basic flight instruments. The navigation displays of the ADI present the following: glide slope displacement showing the aircraft in relation to a glide slope beam; computed pitch steering information indicating direction of stick movement to intercept and maintain (asymptotic approach) the glide slope beam; computed bank steering information indicating stick movement to intercept and maintain (asymptotic approach) a selected heading, Doppler course, or localizer beam. The steering bar has become centered when the correct control action has been taken. The navigation displays of the HSI present the following heading to steer to a Doppler destination, or a desired TACAN course; Doppler ground track; to or from indication in relation to a TACAN station; TACAN or ILS course deviation; bearing to a UHF station, or TACAN station, great circle course to fly to a destination; distance in nautical miles to a Doppler destination, or a TACAN station.

Note

- [F] When changing the instrument mode selector switch from Doppler to TACAN, the course readout on the HSI will indicate the Doppler course unless reset by the pilot.

If the steering bar (needle) switch is OFF when the instrument selector switch is moved through the ILS-OUTBND position to the ILS-LCL or ILS-FINAL position and then returned to ILS-OUTBND, the bank steering bar will appear. To drive the bank steering bar out of view place the steering bar (needle) switch ON then OFF.

Command Markers.

Command markers are double lined moving indexes located on the AMI, AVVI and HSI. The markers serve as memory indexes, and provide visible indications of desired altitude, airspeed, and heading information in relation to the horizontal and vertical reference lines. Command readout windows numerically display the selected information below the corresponding scales of the AMI, AVVI and the HSI. The markers are fly-to indexes. Depending on their position in relation to the horizontal or vertical reference lines a corresponding stick, rudder, or throttle movement is required to align the marker with the fixed horizontal or vertical index line.

Note

If the command slewing switch is moved to the detented position on the right, the command airspeed marker will align with the fixed index and continuous presentation of the airspeed will then be displayed on the moving scale and in the readout window.

Instrument Tolerances. [F]

Possible span of the integrated instrument readings between the front and rear cockpits are as indicated below. Allowances have been made for extremes of tolerance bands although the instruments are within specification requirements.

Altitude Vertical Velocity Indicator (AVVI).

Altitude scale	50 feet
Vertical Velocity	150 ft/min at 0 ft/min 1000 ft/min at 40,000 ft/min

Attitude Director Indicator (ADI).

Pitch and roll	2 degrees
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Airspeed Mach Indicator (AMI).

Mach scale	0.010 Mach
------------	------------

Command Mach marker	0.010 Mach
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Max allowable mach number	0.020 Mach
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Airspeed indicator	4 knots
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Command airspeed marker	10 knots
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Accelerometer	0.2G
---------------	------

Horizontal Situation Indicator (HSI).

Heading	1 degree
---------	----------

Distance to go	8 Nautical miles
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Integrated Flight Instrument System Operation.

A typical flight will be described here to provide a means of familiarizing the pilot with the system and use of the command markers as memory indexes. This does not attempt to cover techniques nor all the functions of the system but covers only the manual mode.

Before Takeoff.

1. Steering bar switch — ON.
2. Instrument selector switch — MAN.
3. Align aircraft on runway.
4. Rotate heading set knob on HSI until bank steering bar on the ADI centers.
5. Set command Mach marker to desired climb Mach by use of the slewing switch and reference to the Mach readout window on the AMI.
6. Set command airspeed marker as desired (wheels up, takeoff speed, etc.) by use of the command airspeed slewing switch and command airspeed readout window on the AMI.
7. Set command altitude as desired (level-off altitude, etc.) by use of the command altitude slewing switch and command altitude readout window of the AVVI.
8. Check compass sync, and ADI pitch trim knob position.

Takeoff.

Accomplish normal takeoff. After lift-off, heading and attitude information is easily available by reference to the bank steering bar and sphere of the ADI.

After Takeoff.

Allow the aircraft to accelerate to best Mach number set in to the AMI prior to takeoff. When the command Mach marker coincides with the horizontal index, adjust controls to hold the marker in alignment with the index. As the command altitude is approached the command marker will start descending toward the horizontal index. Monitor the vertical velocity scale for indications of the rate at which the Command altitude is being approached. Apply controls to bring the altitude marker in alignment with the horizontal index. After level-off, set desired airspeed or Mach using the slew switches and readout windows and any desired heading using the heading set knob and heading marker of the HSI. Accelerate until command markers are aligned with the horizontal reference line, and bank to desired heading, keeping the bank steering bar centered during bank and roll out. The aircraft heading is numerically shown in the course selector window of the HSI when in manual mode. When making turns, if airspeed falls, the command marker will move below the horizontal index on the AMI indicating to the pilot that forward stick or increased throttle is required to align the marker with the fixed index.

Before Landing.

Set descent airspeed by use of the command airspeed slewing switch and command airspeed readout window on the AMI. Set the desired approach altitude by use of the command altitude slewing switch and readout window on the AVVI. Any variation in airspeed during letdown is immediately detected if the command airspeed marker moves from the horizontal reference line. Monitor the vertical velocity scale for indications of the rate at which the command altitude is being approached. Level off so the command altitude marker is aligned with the horizontal reference line. Set approach airspeed by using the slew switch and readout window. During final approach and flareout the angle of attack scale on the AMI is monitored to insure proper margin of speed to complete a normal (flaps down) landing. The best approach, 50 foot obstacle and touchdown speeds are indicated by aligning portions of the final

approach symbol with the fixed index line. That portion of the final approach symbol near the letter A (in the word FINAL), when aligned with the fixed index line, defines the angle of attack corresponding to the recommended speed for final approach. The letter F corresponds to the optimum 50 foot obstacle speed and that section midway between the final approach symbol and the hatched minimum safe speed area represents the angle of attack corresponding to the recommended touchdown speed.

Note

The position of the final approach symbol is only valid when the aircraft is in the landing configuration (gear and TE flaps down).

- The most useful feature of the angle of attack scale is that the optimum approach speed will always be at the same indication regardless of aircraft gross weight. Therefore, if this fixed optimum angle of attack is held the speed will automatically be correct for various gross weights. The same is true for the 50 foot obstacle and touchdown speeds.

INSTRUMENT SELECTOR SWITCH.

Since the attitude director and horizontal situation indicators of the integrated flight instrument system receive electrical signals from a number of navigational systems, an instrument-selector switch (27, figure 1-3) on the main instrument panel selects any one of the six available modes of operation. The switch is operative in the cockpit with control of the FLIGHT take-over system. The switch is a rotary detented type, placarded INSTRUMENT SELECTOR having the following positions: MAN (manual), DOPPLER, TAC (Tacan), ILS OUTBND, ILS LCL (localizer) and ILS FINAL (and an additional DL position on  aircraft). With the switch in MAN position, the following indications appear on the horizontal situation indicator: The MAN mode indicator light is illuminated, the compass card indicates aircraft heading (in all instrument-selector switch positions), the bearing pointer is fixed in alignment with the upper lubber line, the range indicator is covered, the course arrow is aligned with the upper lubber line, the course-selector window indicates aircraft heading, the heading marker indicates manually set heading, the to-from indicator is out of view, and the course deviation indicator is centered in alignment with

the course arrow. With the switch in MAN the following indications will appear on the attitude director indicator; glide slope warning flag, the glide slope indicator and pitch steering bar will be out of view. The attitude sphere, turn and slip indicator, and the bank steering bar will function normally in any of the switch positions. The bank steering bar indicates, when centered, that the desired heading is being maintained. For indicator displays when the switch is in other positions, see figure 1-55. In addition there are two submodes. They are; the fire control, and ADF modes, which are activated when the freeze/fire button is depressed or the command radio function switch is placed in ADF. When the freeze/fire button is depressed, regardless of the position of the instrument-selector switch or the steering bar (needle) switch, all information for the bank steering bar of the attitude director indicator is cancelled and the bar is used as a roll indicator. When the command radio function switch is at ADF, the bearing pointer of the HSI will indicate the bearing to the UHF station. The instrument-selector switch is powered by DC secondary power.

TACAN RADIO AN/ARN-62.

The equipment is the airborne portion of the short range air navigation system called TACAN (Tactical Air Navigation). It is a UHF navigation receiver transmitter with associated indicators that provide reception of bearing, distance, and tone identity information, to show the location of the aircraft with respect to a specifically constructed surface navigation beacon. A total of 126 channels are provided and spaced one megacycle apart. Transmission frequencies for distance measuring pulses transmitted by the radio set and returned by the ground beacon are in the 1025 to 1150 MC range. The receiver is automatically tuned to a corresponding receiving channel which is located in a frequency range on either side of the transmitting channels. Channels 1 through 63 utilize 962 through 1024 MC, and 64 through 126 utilize 1151 through 1213 MC. This system enables an equipped aircraft to obtain continuous indications of its distance and bearing to any selected TACAN surface beacon located within a line of sight distance of up to 200 nautical miles (dependent upon altitude).

Note

If the distance range of 200 miles is exceeded, a range warning flag drops across the figures of the range indicator on the HSI. However, the bearing to the station may be shown by the bearing pointer on the HSI.

TACAN AN/ARN-62 control panel

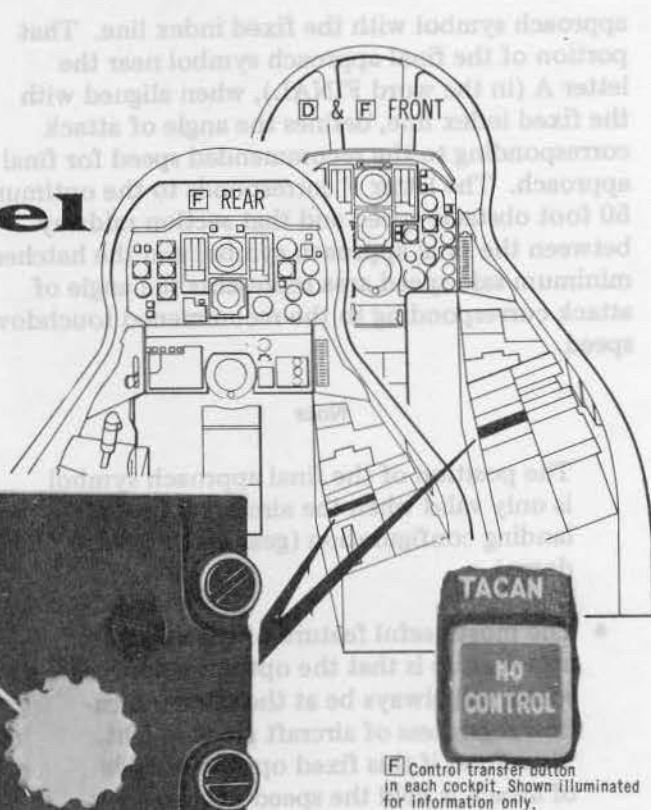


Figure 1-56

Note (Continued)

- If TACAN is inoperative or bearing signals are weak or unreliable, the pointer will rotate or search rapidly to prevent erroneous information from being presented.

The TACAN radio utilizes the HSI, a control panel (figure 1-56), and the instrument-selector switch. The control panel is marked TCN and contains a function-switch, volume control, and two channel-selector knobs. Display of the information selected by positioning of the channel-selector knobs will appear on the HSI. The equipment operates at altitudes up to 50,000 feet. The TACAN set is powered by the CIN power supply and normally operates from the AC and DC powered modules of the power supply. If certain DC powered modules fail or command radio voltage falls below normal level, the command radio goes into back-up operation (operation on AC only). At such a time, the CIN PWR caution light will illuminate indicating the TACAN radio may be inoperative. Also, in the event of AC secondary power failure, the TACAN set would be inoperative.



Note

The bearing pointer presents both magnetic and relative bearing to the station selected, as long as the HSI compass card is functioning normally. If there is a malfunction in the compass system or compass card, the bearing pointer information should be considered unreliable until verified by radar or other navigational aids as either relative or magnetic bearing.

- When in the TACAN mode, the bearing pointer will search, or rotate if signals from the TACAN radio are unreliable or weak. Occasionally TACAN equipment will misinterpret received signals and indicate a false bearing which will be 40 degrees or a multiple of 40 degrees in error. These errors may be on either side of the correct bearing and occur because the bearing search stopped at a false point. Recycling the search mode by switching

Note (Continued)

to another frequency and back to the desired one, or by turning the TACAN equipment OFF then ON, will usually result in a correct bearing indication.

Tacan Control Transfer (Take-Over) Buttons. [F]

The Tacan control transfer (take-over) button (figure 1-62) permits transfer of TACAN control between cockpits. The buttons are solenoid-held pushbutton switches placarded TACAN, and pressing the button in either cockpit transfers control of the TACAN radio to that cockpit. Each TACAN take-over button contains an integral legend type indicator light which illuminates displaying NO CONTROL in the cockpit that does not have control of the TACAN control panel. The button is powered from DC secondary power and the indicator light is powered by AC primary power. Refer to section I for details of the control transfer (take-over) system.

Note

- [F] Using the Instrument Selector Switch to control display selection in both cockpits, the FLIGHT control transfer (take-over) button in the cockpit desiring control must be depressed. Course selector knob selection transfers with TACAN take-over.
- [F] • Anytime the instrument mode selector switch is at TAC, TACAN information is presented in both cockpits regardless of cockpit having control of the TACAN. However, TACAN course information will be correct only in the cockpit with TACAN control unless identical courses are selected.

Channel-Selector Knob.

The channel-selector knob (figure 1-56) selects the desired navigation beacon channel. The left-hand knob selects the tens and hundreds figures of the beacon channel number, and the right-hand knob, the unit figure. Combinations of settings may be made from 00 to 129, but the equipment operates on channels 12 to 126 only. The frequencies selected are shown in a window marked CHANNEL.

Function Switch.

The function switch (figure 1-56) has three positions marked OFF, REC, and T/R. When CIN power is available, power is applied to a time-delay relay and

to the TACAN set regardless of the position of the function-switch. The time-delay relay closes after about 70 seconds and remains closed as long as power is applied. Filament voltage is thus applied to the TACAN even though the function-switch is in the OFF position and provides the so-called "Stand-by" condition. The REC position places the receiver portion of the equipment into operation so that only bearing information is furnished with no warm-up delay. In the T/R position, the airborne equipment transmits a distance-measuring pulse, and receives corresponding reply pulse from the ground beacon to furnish distance information, in addition to bearing information. The distance information is displayed in the range indicator of the HSI. While the indicator is searching for the correct range, the rotating numbers are partially covered by a range warning flag. When the function switch is in the REC position, the numbers remain stationary and are partially covered by the range warning flag. The range warning flag warns the pilot against reading incorrect distance indications. The OFF position places the set in "Stand-by" providing power is available, and no delay occurs when the power control switch is returned to REC or T/R.

Volume Control.

A control (figure 1-56) marked VOL is provided for adjusting the volume of the audio identification signal received from the beacon. Clockwise rotation increases the volume.

Instrument Selector Switch.

For TACAN functions and associated instrument displays, see INSTRUMENT SELECTOR SWITCH in this section.

Horizontal Situation Indicator.

For TACAN functions see HORIZONTAL SITUATION INDICATOR in this section.

Operation of AN/ARN-62 Radio Set.

In the [F] bearing and distance will be displayed and the identification tone heard in both cockpits when the instrument selector switch is in TAC in the cockpit with FLIGHT control.

- [F] 1. TACAN (take-over) button in cockpit taking control — Depress.
- [F] 2. FLIGHT (take-over) button in cockpit taking control — Depress.

Note

- Ⓔ The FLIGHT and TACAN take-over buttons in the cockpit not having control of these functions illuminates, displaying the legend, NO CONTROL.
- 3. Instrument-selector switch — TAC, and observe that mode light on HSI is illuminated and displays TAC.
- 4. Function-selector knob on compass control panel — SLAVED.
- 5. Selected desired TACAN frequency.
- 6. Function switch — T/R or REC.
- 7. Identify station and adjust volume to desired level.
- 8. Manually set into the HSI course selector window the Tacan course which it is desired to fly. The course arrow and course selector window will display the selected TACAN course.
- 9. Check the HSI (and in rear cockpit if applicable) for the following:
 - a. Bearing to the Tacan station as indicated by the bearing pointer.
 - b. Course deviation indicator for deviation from the selected Tacan course.
 - c. To - from indicator indication.

Note

If the function-switch is at T/R, the range indicator will show a decrease in mileage as the aircraft approaches the Tacan beacon and an increase in mileage as the aircraft flies away.

- The receiver may not lock-on in either distance or bearing when switched to a station in the immediate vicinity of the aircraft. If this occurs, turn the function switch to OFF and then back to either T/R or REC. Normal operation should follow.
- If the TACAN set appears to be inoperative on any mode, select other stations

prior to assuming that the airborne equipment is malfunctioning.

- 10. The TACAN set may lock-on to a false bearing which will be 40 degrees or a multiple of 40 degrees in error. (The HSI range indicator DME display is not affected by false lock-on.) Accomplish the following for a false lock-on.
 - a. Cross check for false lock-on with ground radar, R-14 radar, and/or dead reckoning. This is especially important when switching channels or turning set on.
 - b. If false lock-on is suspected, switch to another channel, check for correct bearing and then switch back to the desired channel.
 - c. Check for correct lock-on.
 - d. If false lock-on is still suspected, turn set OFF, then ON.
 - e. Recheck for correct lock-on.
 - f. If false lock-on persists, utilize the other aids or equipment available.
- 11. Check the course deviation indicator (CDI) on the HSI for course information. The course deviation indicator is always directional in the TACAN mode. Correction should be made towards the indicator to correct towards the selected TACAN course.
- 12. Move the function switch to OFF to place the equipment in standby operation.

ILS RADIO RECEIVER SET AN/ARN-61.

The AN/ARN-61 radio is a VHF navigation receiver with associated indicator and controls that provide visual and aural reception information of the localizer, glide slope, and marker beacon facilities when making an instrument landing system (ILS) approach. The localizer and glide slope operate on 20, fixed, separate frequency channels. The localizer frequencies range from 108.1 to 111.9 MC. The glide slope frequencies range from 329.3 to 335.0 MC. The selected localizer frequency is shown in a window marked LOC FREQ MC on the control panel. The selection of the glide slope frequency is automatically paired with the localizer frequency and not displayed. Whenever the aircraft is over or adjacent to a 75-megacycle marker beacon facility, the marker

ILS AN/ARN-61 control panel

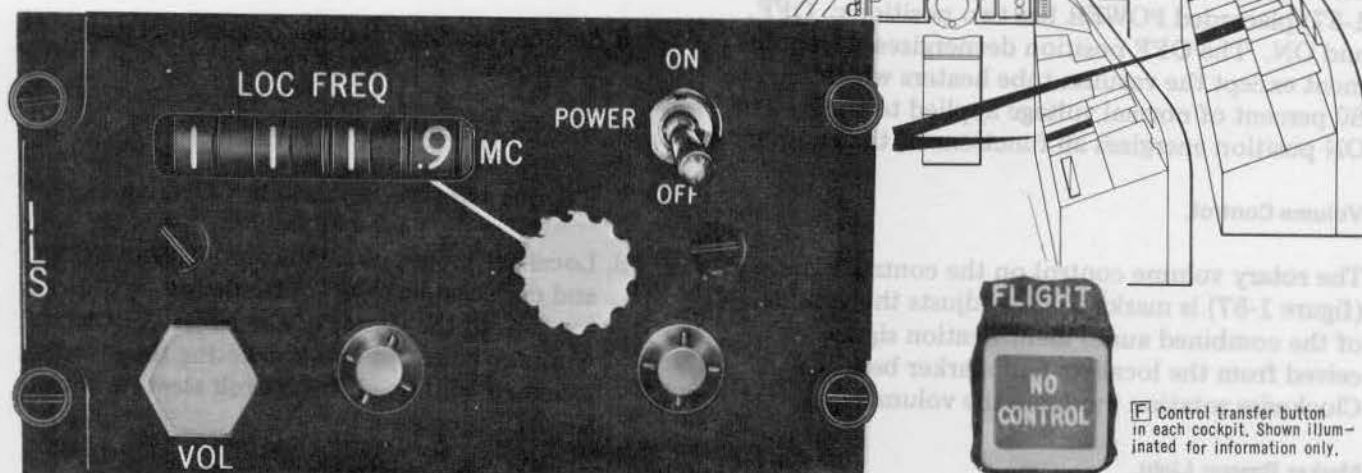


Figure 1-57

beacon receiver will illuminate the marker beacon indicator light and delivery the transmitted audio signal to the headset, provided the ILS receiver is ON. Two warning flags become visible adjacent to the glide slope indicator and at the upper end of the bank steering bar on the attitude director indicator (ADI) whenever the signal level from the selected frequency is too weak to be reliable. The AN/ARN-61 control panel (figure 1-57) is marked ILS and has a function switch, volume control and frequency selector knob. In the [F] a control transfer button in each cockpit placarded FLIGHT permits transfer of ILS radio control between cockpits. Display of on course, glide slope, and marker beacon information will appear on the horizontal situation and attitude director indicator and by illumination of the marker beacon light. The ILS receiver is tied into the AFCS to provide selection of an automatic instrument landing approach. When used, the aircraft is guided to the landing runway by the AFCS. No control movement by the pilot is required until 200 feet above terrain, at which time the pilot assumes control. If the AFCS emergency disconnect lever (in either cockpit of the [F]) is used, stab-aug will have to be reengaged. The ILS system is powered by the CIN power supply and normally operates from an AC powered module of

the power supply. If the AC powered ILS CIN module fails or AC or DC secondary power fails, the ILS set will be inoperative.

Flight Control Transfer (Take-Over) Button. [F]

The flight control transfer (take-over) button in each cockpit (figure 1-62) permits transfer of ILS radio control between cockpits and is powered from DC primary power. The buttons are solenoid-held pushbutton switches placarded FLIGHT, and pressing the button in either cockpit transfers control of the ILS radio to that cockpit. The button in each cockpit contains an integral legend type indicator light which illuminates and displays NO CONTROL in the cockpit that does not have control of the ILS set. The button is powered by DC primary power and the indicator light is powered by AC primary power. See section I for details of the control transfer (take-over) system.

Frequency-Selector Knob.

The frequency-selector knob (figure 1-57) located on the control panel selects the localizer frequency desired. One rotation of the knob covers the full range of the frequency display. A detented position.

is provided for each frequency increment in the localizer range of 108.1 to 111.0 MC. Display of the frequency is in odd tenths of a megacycle and shown in the window marked LOC FREQ MC. The glide slope frequency is automatically paired with the localizer frequency and is not shown. Rotating the knob clockwise increases the frequency shown.

Function Switch.

The function switch on the control panel (figure 1-57) placarded POWER has two positions: OFF, and ON. The OFF position deenergizes the equipment except the vacuum tube heaters which have 80 percent of normal voltage applied to them. The ON position energizes all functions of the equipment.

Volume Control.

The rotary volume control on the control panel (figure 1-57) is marked VOL, adjusts the volume of the combined audio identification signals received from the localizer and marker beacons. Clockwise rotation increases the volume.

Marker Beacon Light.

The marker beacon light (figure 1-60) on the main instrument panel displays MARKER BEACON and when illuminated indicates that the aircraft is directly over an ILS marker when using the ILS navigation system. The light is powered from DC primary power.

Instrument Selector Switch.

For ILS functions and associated instrument displays see INSTRUMENT SELECTOR SWITCH, in this section.

Attitude Director Indicator.

For ILS function, refer to ATTITUDE DIRECTOR INDICATOR in this section.

Operation of AN/ARN-61 Radio.

☐ The frequency selected is only displayed on the control panel in the cockpit in control of the ILS system. Display of localizer glide slope, marker beacon and identification tone is operative in both cockpits if the instrument selector switch in the cockpit with control of the ILS system is in ILS FINAL or ILS-LCL. All the above indications will also be displayed in ILS OUTBND with exception of glide slope.

- ☐ 1. FLIGHT take-over button in cockpit taking control of the ILS radio — Depress.
2. Function switch — ON.
3. Select the localizer frequency to be used.
4. Identify ILS facility and adjust volume to a comfortable level. Do not turn volume down completely as some ILS stations broadcast traffic instructions on the localizer frequency.
5. Set the localizer inbound course in course-selector window of the HSI.
6. Instrument-selector switch — ILS LCL.
7. Steering bar (needle) switch — ON.
8. Localizer intercept is indicated by unpegging and deflection of the course deviation indicator toward the center of the HSI. The correct bank for intercept and bracketing the localizer is being maintained if the bank steering bar of the ADI is centered.

WARNING

A normal ILS approach must not be attempted if there is no deflection of the course deviation indicator on the HSI or glide slope indicator on the ADI or the course warning and glide slope warning flags are visible in a steady state as this indicates an inoperative or unreliable ILS system. If the course warning flag is visible the course deviation indicator on the HSI and bank steering bar on the ADI are unreliable.

- If an automatic ILS approach is made using the AFCS tie-in, after intercepting the localizer beam, the ILS switch on the AFCS panel must not be engaged if there is no deflection of either the bank steering bar or the course deviation indicator, or if the glide slope indicator does not have an upward deflection or if either the course warning flag or the glide slope warning flags on the ADI are in view.

Note

If a back course intercept is made or flown, the front approach course must

Note (Continued)

be set in the course selector window, in order to obtain directional indications from the course deviation indicator. The bank steering bar will be unreliable or nondirectional anytime the aircraft heading is more than 90 degrees from the selected localizer front approach course.

9. Observe position of the localizer beam by the position of the course deviation indicator of the HSI. The aircraft is on the localizer course when the course deviation indicator is aligned with the course arrow.
10. The ILS FINAL mode may be selected as soon as the aircraft is inbound at approach altitude on the localizer beam provided that:
 - a. There is deflection of the bank steering bar and the course deviation indicator.
 - b. The glide slope indicator has an upward deflection.
 - c. Both the course warning and glide slope warning flags are not visible.

Note

In this mode wind drift corrections will be accomplished automatically. Consequently centering the bank steering bar will result in an aircraft flight path along the centerline of the localizer approach course. The pitch steering bar will come into view when switching to ILS-FINAL. However pitch correction should not be made until the glide slope indicator approaches center.

11. Glide slope indicator monitor. When the glide slope indicator approaches center, adjust pitch attitude as necessary to center the pitch steering bar.
12. Thrust — Adjust as necessary. While keeping the steering bars centered, adjust thrust as necessary to maintain desired airspeed.
13. Approach — Continue. Adjust pitch and bank attitudes to keep steering bars centered. When the bars are centered, they indicate that the proper attitude is being held to maintain localizer course and glide slope, or the aircraft is correcting back at the proper rate.

Note

Cross check, as necessary, the glide slope indicator and course deviation indicator to insure aircraft is on course and glide slope.

14. Marker beacon lights — Monitor. Monitor beacon lights during approach to maintain prescribed altitude at appropriate check points.
15. Minimum altitude — Check. If visual references are insufficient to land at minimum altitude, execute published missed approach procedure.

For auto ILS approach operation refer to AFCS in this section.

DOPPLER NAVIGATION SYSTEM AN/APN-131.

The AN/APN-131 Doppler navigation system is an automatic, self-contained navigator with associated controls and indicators that show a direction and distance to fly from a present position to a selected destination. The system computes a solution for a navigational problem, along a great circle course to a maximum of 2000 nautical miles over any portion of the earth's surface. During flight the present position in latitude and longitude, course and distance to a destination, ground track, ground speed, and drift angles are continuously displayed. The Doppler system is integrated with other aircraft systems for proper operation. These are: the all attitude compass system for heading information; the air data computer for true airspeed; the horizontal situation indicator for display of ground track, course to destination and distance to destination, and the attitude director indicator for steering information. The Doppler navigator also ties in with the automatic pilot to provide automatic navigation to the preset destination, and with the fire-control system to provide track-hold during the bombing modes. The Doppler navigation system transmits three beams of microwave energy to the ground through three antenna horns, and receives the ground reflected energy (echoes). The frequency of the received signals is compared to the frequency of the transmitted signals. The difference in frequency for each beam is resolved into a north-south velocity and an east-west velocity. These are used to compute ground track, drift, and ground speed. These quantities are gyro stabilized so that aircraft attitude has no effect for pitch and bank angles below 28 ± 1 degrees. The Doppler shift is integrated with heading information from the all-attitude compass

system in the navigational computer. The computer, which has initial position and destination set into it on the Doppler control panel by the pilot, performs the necessary functions to provide present position ground track, great circle course to destination, ground speed, and drift angle. Display of this information from the computer is shown on the HSI, the counter windows of the Doppler control panels, and the ground speed and drift angle indicator. The AN/APN-131 system is powered by AC secondary, and DC secondary power.

Doppler Control Transfer (Take-Over) Buttons. [F]

The Doppler control transfer (take-over) button in each cockpit (figure 1-62) permits transfer of control of the Doppler system between cockpits. The buttons are solenoid-held pushbutton switches placarded NAV, and pressing the button in either cockpit, if the Doppler control panel heading reference switch in that cockpit is at DG or MAG, transfers control of the Doppler system to that cockpit. Control of the Doppler system cannot be taken over by one cockpit unless the Doppler control panel heading reference switch in the cockpit taking control is placed at DG or MAG prior to engaging the NAV take-over button. If the front cockpit has control of the Doppler system and the Doppler heading-reference switch is placed at OFF, the front cockpit still retains control if the rear cockpit heading reference switch is placed at DG or MAG. The above is also true for the aft cockpit. The front cockpit has control of the Doppler system after initial application of aircraft power by placing the heading reference switch at DG or MAG whether or not the front NAV take-over button is engaged. If both cockpits have the heading reference switch at DG or MAG and the rear NAV take-over button is engaged, depressing the front NAV take-over button will disengage the rear NAV take-over button and the front cockpit assumes control. The opposite is true if the front NAV take-over button is engaged and the rear NAV take-over button is then depressed. Each NAV take-over button contains an integral legend type indicator light which illuminates displaying NO CONTROL in the cockpit that does not have control of the Doppler system. The button is powered by DC primary power and the indicator light is powered by AC primary power. Brightness of the indicator lights are controlled by the FLIGHT INST interior lights control.

Note

- [F] Display of ground speed, drift angle, track, distance, latitude and longitude

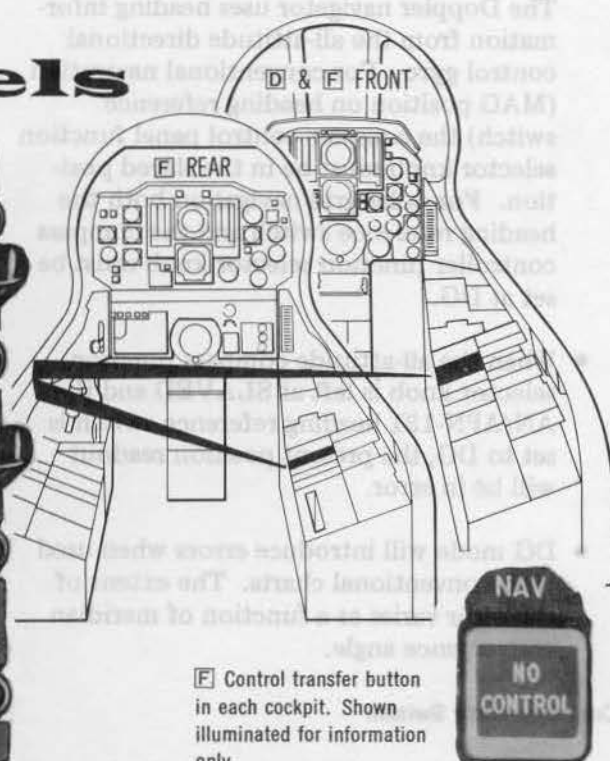
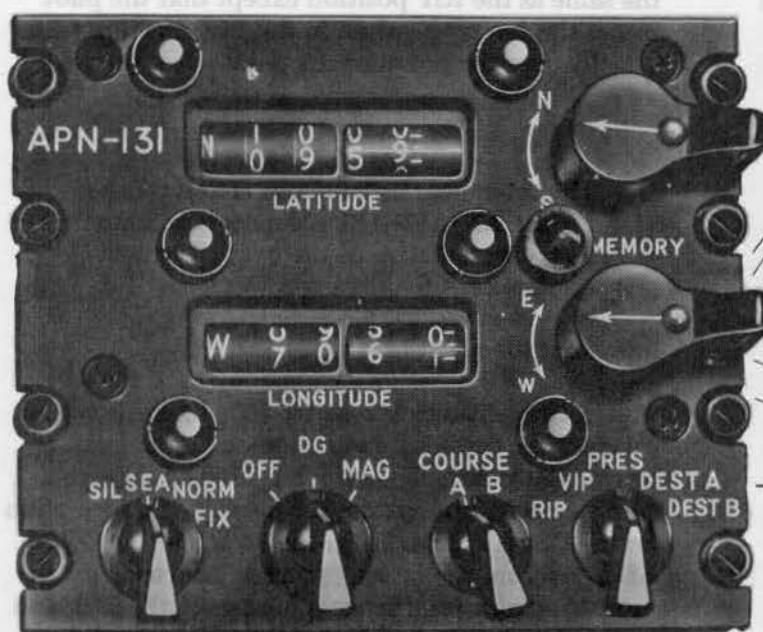
will be continuously displayed in both cockpits regardless of which cockpit has control.

- [F] • The instrument selector switch in the cockpit with the FLIGHT take-over button engaged must be set at DOPPLER to obtain HSI and ADI displays in both cockpits.
- [F] • Transfer of Doppler (engaging NAV take-over button) between cockpits also disengages all AFCS modes except STAB-AUG and transfer control of the compass control panel.
- [F] • Engage NAV take-over button only in wings level attitude to minimize heading change during NAV transfer. Magnetic compass should be cross checked after each transfer to insure system is operating within tolerances.

Function Switch.

The function switch (figure 1-58) is a four-position switch with positions placarded; SIL, SEA, NORM and FIX. The SIL position is used for radar silence when it becomes necessary during flight to discontinue transmission of microwave energy (a precaution against detection). When placed in the SIL position, the switch cuts off power to the transmitter. With no transmission and the resulting loss of Doppler return, the navigator, after a one second delay, will operate on wind memory, whenever the trackers cease tracking. Doppler returns from any one or all the antenna beams either by institution of radar silence or other reasons, the system will switch to memory operation. The SEA position switches the computer to a sea state condition, introducing a constant factor that will compensate for the over-water bias errors insuring true present position information. If over a water mass and the function switch is not placed in the SEA position, the result will be an approximate three percent error in computation of present position for an average sea. The NORM position activates the system and is used at all times except when over a water mass, when radar silence is required, or when a new fix is to be made enroute. The FIX position allows the pilot to correct his present position display automatically when over a preset destination radar or visual fix as long as the coordinates of the fix are less than 50 nautical miles away from the present position indicated. It also allows him to correct his present position display manually as long as the correction is completed

DOPPLER AN/APN-131 control panels



E Control transfer button in each cockpit. Shown illuminated for information only.

Figure 1-58

within 1 degree and 42.4 minutes of latitude and longitude.

Note

- D In some aircraft, between serial numbers 58-1171 through 60-470, a gyro simulator has been installed in the CU448 Doppler antenna in place of the standard gyro. These aircraft will have the notation, "MOD-5" grease-pencilled on the Doppler antenna unit in the right, auxiliary, electronic compartment. The simulator supplies fixed pitch ($2\frac{1}{2}$ degree) nose up signals, and zero degree roll signals, to the Doppler system. Doppler data is, therefore, not corrected as a function of actual aircraft attitude. When performing in the dive bombing mode it is necessary to place the operate switch in the SIL position. This places the Doppler system in memory mode and assures that the solution light will function normally. On these aircraft the memory light will not illuminate at 28 ± 1 degree pitch and/or bank.

Heading Reference Switch.

The heading reference switch (figure 1-58) is a three-position rotary switch used to select the source of heading information. The positions are placarded OFF, DG, and MAG. When at OFF, the Doppler system is inoperative. The DG mode is used for latitudes above 75 degrees where the variation can in the AN/APN-131 becomes unreliable. With the all-attitude compass function selector knob (figure 1-46) in the DG position, the gyro of the all-attitude compass system is freed from the control of the magnetic north-seeking transmitter, and is now latitude corrected. The compass system can now be set to indicate true north and to feed heading information corrected to true north into the Doppler computer. The MAG position utilizes the all-attitude system directional gyro for inputs of magnetic heading and should be used at all latitudes except high, or polar. In this mode of operation, the compass system function-selector knob must in the SLAVED position to feed magnetic north reference signals to the Doppler computer.

Note

The Doppler navigator uses heading information from the all-attitude directional control gyro. For conventional navigation (MAG position on heading reference switch) the compass control panel function selector knob must be in the slaved position. For polar grid navigation both the heading reference switch and the compass controller function selector knob must be set at DG.

- When the all-attitude compass function selector knob is left at SLAVED and the AN/APN-131 heading reference switch is set to DG, the present position readout will be in error.
- DG mode will introduce errors when used with conventional charts. The extent of the error varies as a function of meridian convergence angle.

Course-Selector Switch.

The course-selector switch (figure 1-58) is a two-position rotary switch placarded COURSE, with positions A and B. When positioned to A or B, the course and distance computation to the respective preset destination (A or B) are indicated on each HSI.

Coordinate Display Switch.

The coordinate display switch (figure 1-58) is a five-position switch with positions placarded; PRES, DEST A, DEST B, RIP, and VIP, and is used to set the present position and destinations into the counters, or select visual or radar means for a position fix in flight. PRES is used to set the present position of the aircraft in latitude and longitude into the counter windows. DEST A is used to set the prime destination or a preset check point, and DEST B allows any alternate destination to be set if a prime destination was set on DEST A, or a prime destination to be set if a preset check point was set on DEST A. The two knobs that control the counters can slew them in either direction. The RIP (or radar fix) position is used to automatically fix present position of the AN/APN-131 system while in flight. Guide the aircraft so that the fix point moves down the azimuth cursor on the radar scope. At the exact moment the fix point reaches the junction of the azimuth and range cursors, turn the function switch to the FIX position for an instant, and then place the switch at the desired mode of operation. If a position error exists, the correct stepper motor(s) is energized turning the present position counters until their value is within 1 MIN latitude and 1.3 MIN longitude of the exact position. The VIP (or visual fix) position is essentially the same as the RIP position except that the pilot places the function-switch in the FIX position when visually over the preset check point.

Note

The tolerances listed above are established for the AN/APN-131 computers and are not representative of the over-all system accuracies.

Instrument-Selector Switch.

The instrument-selector switch (27, figure 1-3) is a rotary type, detented switch located on the main instrument panel. The switch is used to select a specific navigation system for display of information on the HSI and ADI. With the switch in the DOPPLER position, the bearing pointer, course arrow, heading marker, and range indicator of the HSI, and the bank steering bar of the ADI respond to signals from the Doppler navigation system.

Note

- ⓔ The cockpit with the FLIGHT control (take-over) button depressed has control of the instrument mode selector switch.

Memory Indicator Light.

The memory indicator light (figure 1-58), on the Doppler control panel is placarded MEMORY. Illumination of the light while the aircraft is on the ground indicates the heading reference switch is at DG or MAG, that power is being supplied to the Doppler navigator and that the aircraft speed is less than 127 knots. Illumination of the light during flight indicates that the Doppler navigator is operating on wind memory. The Doppler will automatically switch to memory for any of the following conditions.

- When the function-switch is positioned to SIL.
- When transmitter power is inadequate.
- When pitch or bank angles are greater than 28 ± 1 degree.

GROUND SPEED and DRIFT ANGLE indicator

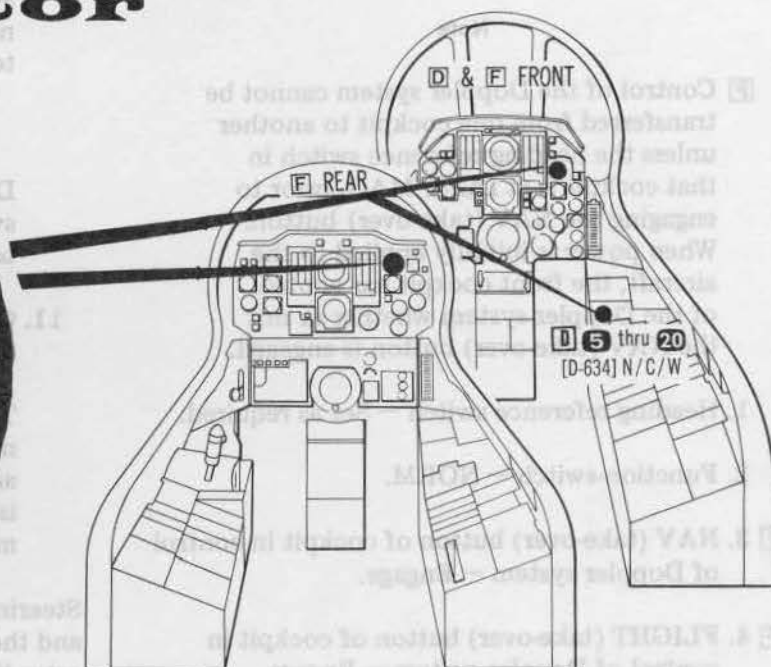


Figure 1-59

Note

- On aircraft S/N 58-1171 through 60-470 in which a gyro simulator is installed instead of a standard gyro, the memory light will not light or the Doppler automatically switch to memory operation when the pitch or bank angles are greater than 28 ± 1 degrees.

In memory operation, the ground velocity and distance traveled are computed by using the stored wind, heading from the all attitude compass system, and airspeed from the CADC. When the Doppler system returns to normal operation, the light will go out. The light can be dimmed by rotating the light itself. On **D 5** aircraft the memory light is dimmed by positioning the WARN LTS switch on the interior lights panel to DIM.

Ground Speed and Drift Angle Indicator.

The ground speed and drift angle indicator (figure 1-59) is located on the main instrument panel and displays the true ground speed in knots and degrees of drift, left or right. On **D** aircraft **5**

through **20** [D-634] N/C/W the indicator is located on the right console. The ground speed is displayed in a counter window in knots. The needle and counters are operated by Doppler signals. The instrument does not indicate correctly until the aircraft speed exceeds between 127 and 147 knots, and a switch in the Central Air Data Computer closes at which time the memory circuit is activated and the memory light goes off. Ground speed and drift angle are displayed continuously in both cockpits whenever the heading reference switch is placed in MAG or DG in the cockpit that has NAV control.

Attitude Direction Indicator.

For display of Doppler information, see ADI (Attitude Director Indicator) and figure 1-52.

Horizontal Situation Indicator.

For display of Doppler information on this indicator, see HORIZONTAL SITUATION INDICATOR, and INSTRUMENT SELECTOR SWITCH in this section.

Operation of AN/APN-131 Doppler System.

Preflight.

Note

- Ⓔ Control of the Doppler system cannot be transferred from one cockpit to another unless the heading reference switch in that cockpit is at DG or MAG, prior to engaging the NAV (take-over) button. When power is initially applied to the aircraft, the front cockpit has control of the Doppler system whether or not the NAV (take-over) button is engaged.

1. Heading reference switch — Set as required.
2. Function-switch — NORM.

- Ⓔ 3. NAV (take-over) button of cockpit in control of Doppler system — Engage.

- Ⓔ 4. FLIGHT (take-over) button of cockpit in control of Doppler system — Engage.

5. Instrument selector switch — DOPPLER. Check that the NAV mode indicator light on the HSI is illuminated. Allow a minimum of one minute warmup time before proceeding in order to prevent erroneous counts from being fed into the navigation computer from previous residual counter settings.

6. Steering bar (needle) switch — ON.

7. Course warning flag on ADI and range warning flag on HSI — Out of view.

Disappearance of the flags indicates warmup is completed. If the flags do not disappear after one minute, cycle the heading reference switch to OFF and back and allow one more minute for warmup.

8. Set destination A.

Coordinate display switch — DEST A, use slew knobs to set coordinates of destination A in coordinate indicator windows.

9. Set destination B.

Coordinate display switch — DEST B, use slew knobs to set coordinates of destination B in coordinate indicator windows.

10. Set present position.

Function-switch — FIX, coordinate display switch — PRES, use slew knobs to set coordinates of present position in coordinate indicator windows. Return function-switch to NORM.

Note

Destinations A and B may be rechecked by switching the coordinate display switch back to DEST A or DEST B.

11. Course selector switch — COURSE A. Check distance and magnetic bearing on HSI.

The Doppler is now ready to begin solving the navigational problem for the great circle course and distance to destination. When the aircraft is in motion, the coordinate indicator will automatically show the changing present position.

Steering and situation data is displayed on the ADI and the HSI. The bank steering bar of the ADI indicates the direction to steer to make good a great circle course. The heading marker of the HSI shows the heading to fly to make good a Doppler great circle course. The course arrow indicates an actual magnetic ground track; the bearing pointer indicates the great circle course to a preset destination, and the range indicator, the distance to go to a check point or preset destination. Ground speeds and drift angles are read directly from the ground speed and drift angle indicator. Drift angle is shown by the indicator needle in degrees either to the left or right, and ground speed directly in knots in the counter window.

When it is intended to operate over water, turn the operate switch to SEA for water bias compensation just prior to leaving land. The system is designed so that it will continue to operate in a normal manner as long as the sea is not calm. Normal operation is indicated by the ground speed and drift angle readings being the same over the water as they were over land. As long as the system gives good ground speed and drift angle readings at the SEA position, the pilot can update the wind information at any time by switching from SEA to NORM for approximately 10 seconds, then back to SEA. The system must be operating normally at the SEA position for this procedure to be effective. However, if the system is not operating normally at the SEA position because of a calm sea (memory light ON), the operate switch should be placed at SIL which will force the system into memory operation. The operate switch

should then be changed from SIL to SEA periodically to determine whether the surface condition of the water will give good readings.

Note

If the ATM cuts out and is restarted, the Doppler should time in when normal voltage is available. If not, turn the heading reference switch to OFF, then back to its previous position to activate the system. The present position counters must be checked, and if resetting the coordinates is required, turn the function-switch to FIX and set in present position, then turn switch back to NORM.

- Upon experiencing unanticipated memory operation, determine if ground speed and drift angle indications are normal or erratic. If normal; continue to navigate by Doppler. If erratic; use other means to navigate. At least one minute before approaching a position for which the coordinates are known, recycle the Doppler by positioning the heading reference switch to OFF, then return it to its previous position. If normal operation returns, make a present position fix when over the known position.

En Route Fix.

Present Position (Manual) Fix. When a flight is planned over a point where the coordinates are known (check point), the present position coordinates may be checked and if necessary corrected. (The coordinate display switch is normally in the PRES position.)

1. When over check point, if the coordinates on the longitude and latitude indicator are not correct, place function-switch to FIX.
2. N-S and E-W slew switches — Operate to set-in the check point coordinates on the longitude and latitude indicators.
3. Function-switch — NORM.

Note

The distance traveled during the fix procedure will be automatically compensated for provided the fix is completed within the distance travel limits of 102.4 minutes

of longitude and 102.4 minutes of latitude. (Longitude equivalent mileage is reduced as distance from the equator is increased.)

TACAN — VIP Fix. When the gross doppler present position errors are suspected and flight is within 50 miles of a TACAN station as indicated on the HSI, the present position coordinates may be checked and corrected if necessary by flying over the TACAN station.

1. Set the TACAN coordinates in DEST A or B and place the course switch to A or B respectively.
2. Select TAC position on the instrument selector switch and observe the distance to the TACAN, then select DOPPLER position on the instrument selector and compare the doppler distance to the TACAN distance.
3. If the difference in distance is greater than one nautical mile, place the coordinate display switch in VIP position and select TAC on the instrument selector switch.
4. Observe the HSI bearing pointer. When it reverses direction, place the function switch to FIX, and after a moment back to NORM (SEA or SIL respectively).

Note

The distance traveled during the fix procedure will be automatically compensated for provided the fix is completed within the distance travel limits of 102.4 minutes of longitude and 102.4 minutes of latitude. (Longitude equivalent mileage is reduced as distance from the equator is increased.)

- If latitude and longitude fixes are set simultaneously the doppler becomes unreliable.

EMERGENCY EQUIPMENT.

MASTER CAUTION SYSTEM.

The master caution system consists of a caution light panel and a master caution light (figure 1-60). Failure of an associated system will cause a light on the caution panel to illuminate together with the master caution light. Depressing the master caution light extinguishes it; however, the individual

CAUTION - WARNING - INDICATOR lights

TYPICAL D & F front

LIGHTS SHOWN ILLUMINATED FOR INFORMATION ONLY

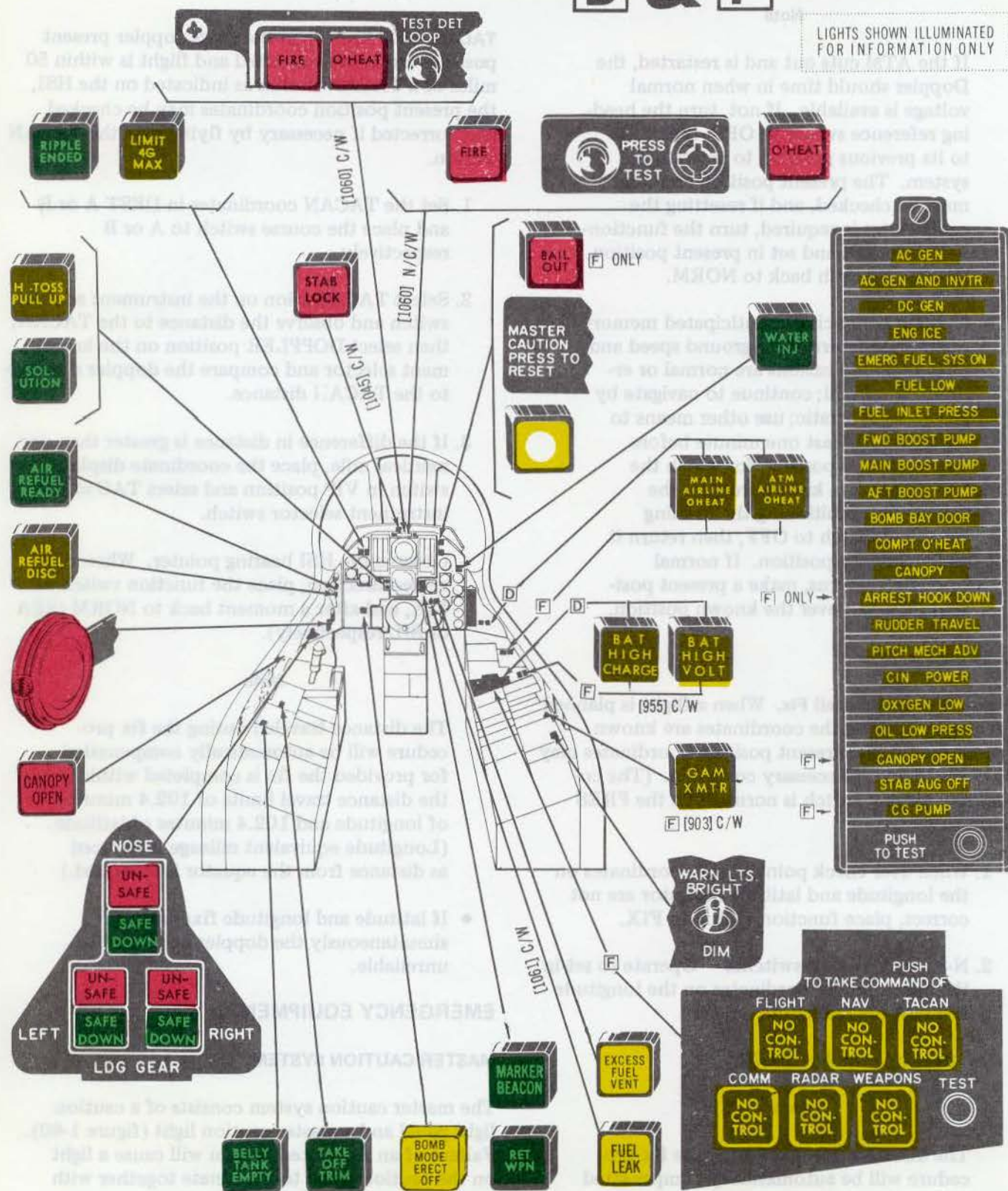


Figure 1-60 (Sheet 1 of 2)

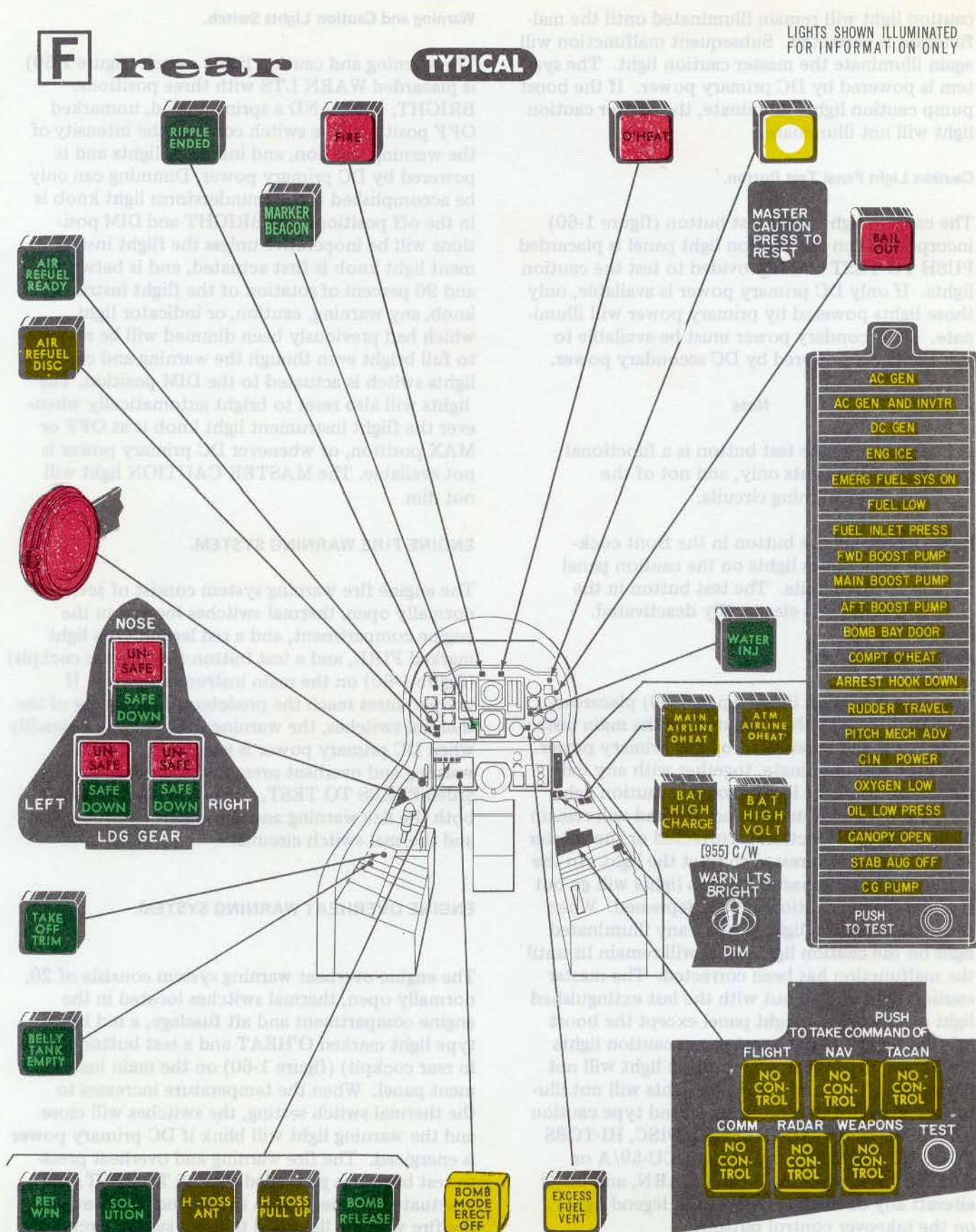


Figure 1-60 (Sheet 2 of 2)

caution light will remain illuminated until the malfunction is corrected. Subsequent malfunction will again illuminate the master caution light. The system is powered by DC primary power. If the boost pump caution lights illuminate, the master caution light will not illuminate.

Caution Light Panel Test Button.

The caution light panel test button (figure 1-60) incorporated on the caution light panel is placarded PUSH TO TEST and is provided to test the caution lights. If only DC primary power is available, only those lights powered by primary power will illuminate. DC secondary power must be available to test the lights powered by DC secondary power.

Note

Depressing the test button is a functional test of the lights only, and not of the complete warning circuits.

- ☐ ● Depressing the button in the front cockpit illuminates lights on the caution panel in both cockpits. The test button in the rear cockpit is electrically deactivated.

Master Caution Light.

The master caution light (figure 1-60) placarded MASTER CAUTION, is located on the main instrument panel and is powered by DC primary power. The light will illuminate, together with any individual caution light located on the caution light panel, when a malfunction occurs, and will remain lit until the malfunction is corrected or the master caution light is depressed to reset the light. In the

☐ aircraft, both master caution lights will go out if either master caution light is depressed. When the master caution light is reset, any illuminated light on the caution light panel will remain lit until the malfunction has been corrected. The master caution light will go out with the last extinguished light on the caution light panel except the boost caution lights. If the boost pump caution lights are illuminated, the master caution light will not illuminate. The master caution lights will not illuminate if any of the following legend type caution lights illuminate: AIR REFUEL DISC, HI-TOSS PULL UP, 4G MAX, any of the DCU-59/A or DCU-102/A UNLOCKED, and WARN, and on ☐ aircraft any of the NO CONTROL legend lights on the takeover control buttons.

Warning and Caution Lights Switch.

The warning and caution lights switch (figure 1-60) is placarded WARN LTS with three positions, BRIGHT, DIM, AND a spring-loaded, unmarked OFF position. The switch controls the intensity of the warning, caution, and indicator lights and is powered by DC primary power. Dimming can only be accomplished if the thunderstorm light knob is in the off position. The BRIGHT and DIM positions will be inoperative unless the flight instrument light knob is first actuated, and is between 10 and 90 percent of rotation of the flight instrument knob, any warning, caution, or indicator light which had previously been dimmed will be restored to full bright even though the warning and caution lights switch is actuated to the DIM position. The lights will also reset to bright automatically whenever the flight instrument light knob is at OFF or MAX position, or whenever DC primary power is not available. The MASTER CAUTION light will not dim.

ENGINE FIRE WARNING SYSTEM.

The engine fire warning system consist of seven, normally open, thermal switches located in the engine compartment, and a red legend type light marked FIRE, and a test button (not in rear cockpit) (figure 1-60) on the main instrument panel. If temperatures reach the predetermined setting of the thermal switches, the warning light will burn steadily when DC primary power is energized. The fire warning and overheat press-to-test button is placarded PRESS TO TEST, and is actuated to check both the fire warning and the engine overheat light and thermal switch circuits.

ENGINE OVERHEAT WARNING SYSTEM.

The engine overheat warning system consists of 20, normally open, thermal switches located in the engine compartment and aft fuselage, a red legend type light marked O'HEAT and a test button (not in rear cockpit) (figure 1-60) on the main instrument panel. When the temperature increases to the thermal switch setting, the switches will close and the warning light will blink if DC primary power is energized. The fire warning and overheat press-to-test button is placarded PRESS TO TEST, and is actuated to check both the engine overheat, and the fire warning light and thermal switch circuits.

CANOPY BREAKER tool

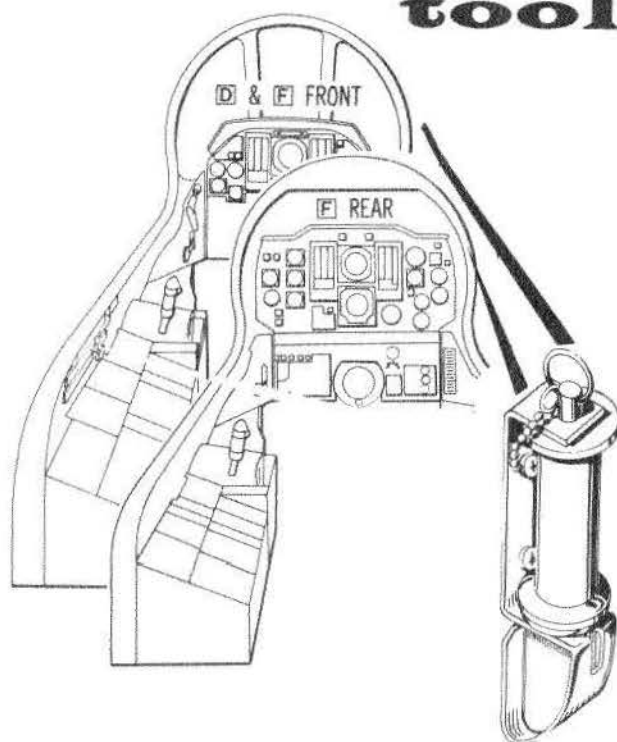


Figure 1-61

FIRE EXTINGUISHING SYSTEM [1060] C/W.

A fire extinguishing system is provided to protect the engine compartment and the bomb bay area. Each compartment is an independent system. The engine compartment system consists of eight normally open thermal switches for fire detection, four fire extinguishing suppressor units and a control unit. The bomb bay area system is identical to the engine compartment system except nine thermal switches are used. Upon detection of a fire in either compartment, two of the suppressor units will immediately discharge into the appropriate area. The engine fire warning light will illuminate indicating that fire existed in one of the surveyed areas. The light will go out automatically after the fire is extinguished. If the fire is not extinguished within 15 seconds after the first suppressor discharge, or if a second fire is detected, the other two suppressor units will automatically discharge into the surveyed area. A manual discharge switch is provided so that the pilot may actuate the fire extinguishing system, which is powered by the battery bus, at any time.

Fire Extinguishing Manual Discharge Switch [1060] C/W.

The fire extinguishing manual discharge switch (not in rear cockpit) located on the main instrument panel is a momentary contact pushbutton switch placarded MAN EXT. A flip cover, spring-loaded to the closed position must be raised to manually discharge the fire extinguishing agent. Depressing the switch will discharge the four fire extinguishing suppressor units in each compartment simultaneously.

CANOPY BREAKER TOOL.

A canopy breaker tool (figure 1-59) is mounted on the right canopy frame aircraft and above the left console aircraft. The tool is released for use by pulling the ring attached to a spring-loaded pin.

CONTROL TRANSFER (TAKE-OVER) SYSTEM. [F]

The control transfer (take-over) system permits transfer of system control between cockpits. The control transfer (take-over) system control panel in each cockpit (figure 1-62) has six solenoid held push-to-engage switches, integral yellow legend type lights in each switch and a spring-loaded press-to-test switch, to simultaneously check illumination of all six legend lights on the panel. Refer to figure 1-62 for take-over button operation and the following paragraphs for details of switch (button) description and systems controlled. The FLIGHT, NAV, COMM and WEAPONS take-over button holding solenoids are powered by DC primary power and the RADAR and TACAN take-over button holding solenoids are powered by DC secondary power. When the power is initially applied to the aircraft, the front cockpit has control of all systems. In the event of a malfunction of the control transfer system or DC power failure in the system, NAV take-over control automatically reverts to the front cockpit. All other take-over control remains with the last station in control until DC power is restored to the take-over control system, at which time all control returns to the front cockpit.

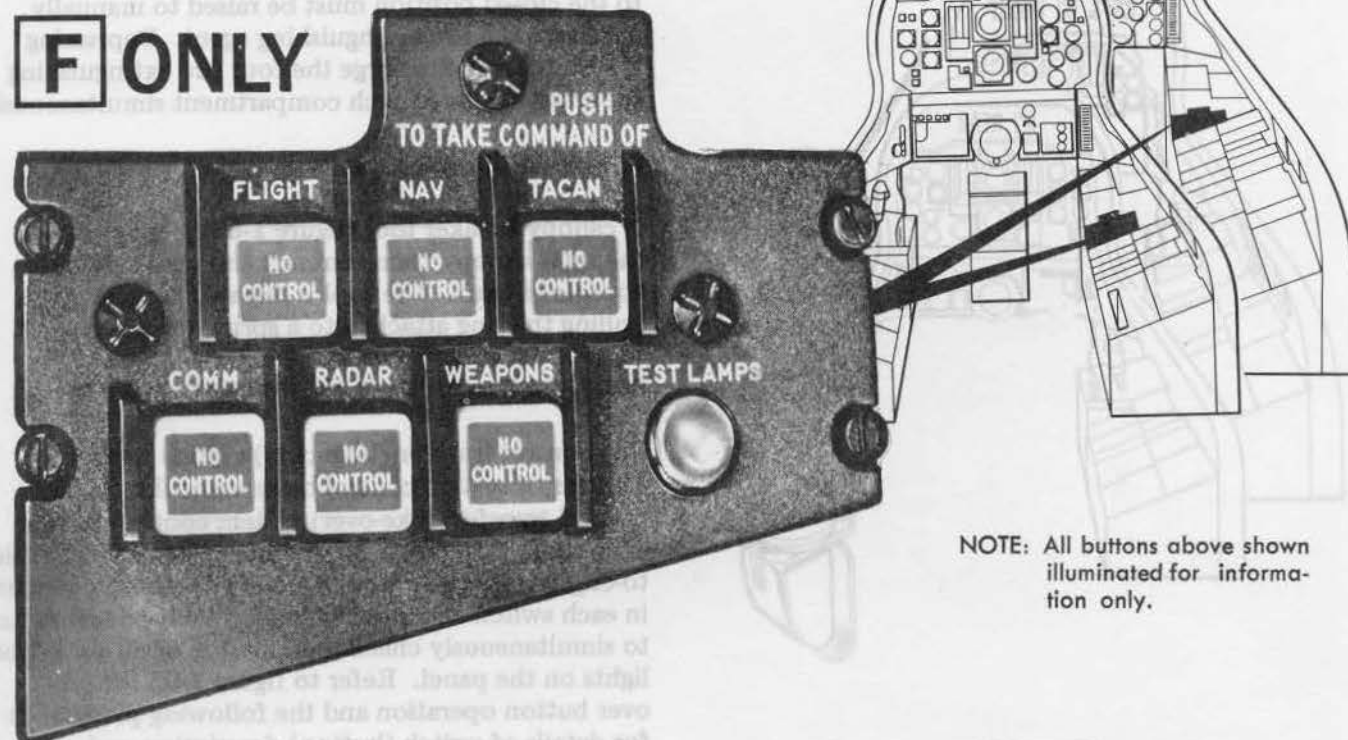
Note

Before taking over a system the crew member taking over should actuate all applicable controls to the appropriate positions required for system operation and then engage the applicable take-over button.

CONTROL TRANSFER (TAKE-OVER) SYSTEM

control panel

AND SYSTEM OPERATION



NOTE: All buttons above shown illuminated for information only.

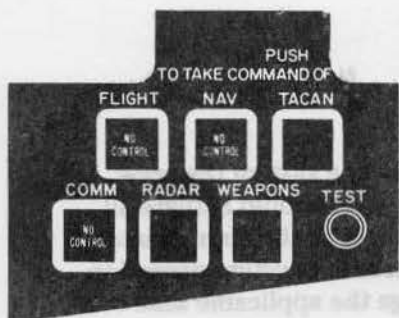
FRONT



WHEN FLYING SOLO

When flying solo or when power initially has been applied to aircraft, FRONT cockpit buttons do not have to be depressed to take control. As the legend light "NO CONTROL" is the only true indicator of what cockpit does not have control, all take-over buttons in the aft cockpit will be illuminated.

FRONT



REAR



REAR



WHEN FLYING DUAL

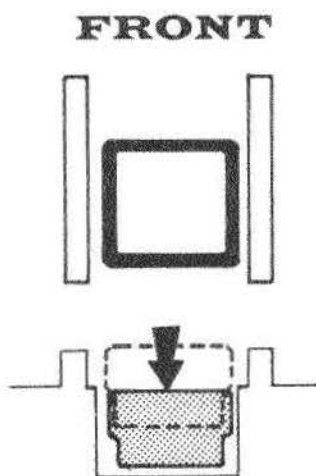
When flying dual, either cockpit can take over control of a system by engaging the appropriate button. The buttons as shown below indicate the front cockpit has control of the TACAN, RADAR, and WEAPONS functions while the rear cockpit has control of the FLIGHT, NAV and COMM functions.

Figure 1-62 (Sheet 1 of 2)

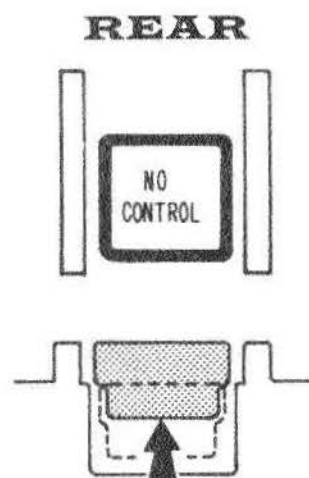
OPERATION

SOLO FLYING requires no take-over button operation. When power is initially applied to the aircraft, all buttons are up, and the front cockpit has control of all systems. DUAL FLYING requires take-over button operation when one pilot elects to take over control of a system presently controlled by the other cockpit.

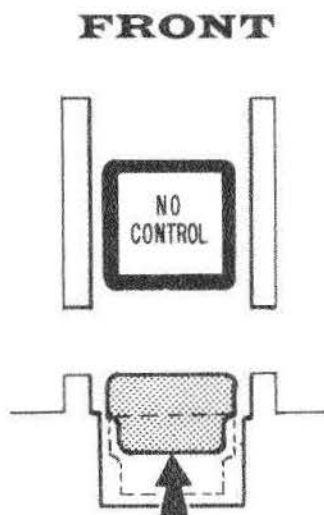
FRONT COCKPIT TAKES OVER CONTROL FUNCTION



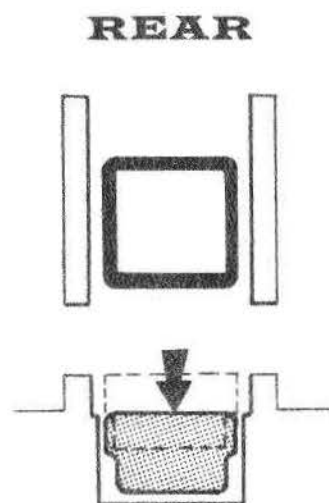
1. Fwd. pilot pushes button to take control of applicable system.*
2. Button remains depressed to signify that the forward cockpit is in command of the control function.
3. Legend light in button is out.
4. Corresponding button in rear cockpit automatically trips to its OFF position (flush with guard).
5. The button will illuminate, displaying the legend "NO CONTROL," to caution the rear pilot that control cannot be exercised as the applicable system circuits are deactivated.



REAR COCKPIT TAKES OVER CONTROL FUNCTION



1. Rear pilot pushes button to take control of applicable system.*
2. Button remains depressed to signify that rear cockpit is in command of the control function.
3. Legend light in button is out.
4. Corresponding button in front cockpit automatically trips to its OFF position (flush with guard).
5. The button will illuminate, displaying the legend "NO CONTROL" to caution the front pilot that control authority cannot be exercised as the applicable system circuits are deactivated.



* NOTES: * Before a pilot takes over a system control function, he must notify the other pilot over the intercom of his intentions to take over. * Before taking over radar control, the fire-control system power switch in the cockpit taking over must be at STBY or ON. This must be done, or when the RADAR take-over button is depressed,

the radar, TBC, and sight system power will be turned off and all fire control information and displays in both cockpits will be lost. Anytime the radar system power is off for any reason, no displays are available until the fire control system power switch in the cockpit with control is at STBY or ON for five minutes.

Figure 1-62 (Sheet 2 of 2)

Control Transfer (Take-Over) Buttons. [F]

The control transfer (take-over) buttons (figure 1-62) are solenoid-held push-to-engage switches located on the control transfer panel on the forward right console and are powered by DC primary power. The control panel in each cockpit is identical, is placarded PUSH TO TAKE COMMAND OF, and contains six take-over buttons placarded FLIGHT, NAV, TACAN, COMM, WEAPONS, and RADAR. Each button contains an integral legend type light which illuminates when power is available and the cockpit does not have control of the particular system.

Note

When DC power is first applied, all cockpit buttons will be disengaged and all front integral indicator lights will be out; however, control remains in the front cockpit and indicator lights in the rear cockpit are on.

- The pilot intending to take control of the FLIGHT system shall notify the pilot with control that he is taking over and check compatibility of affected controls in both cockpits before engaging the FLIGHT take-over button. The pilot intending to take control of RADAR, COMM or TACAN shall first assure that these systems are ON in his cockpit before taking control (radar may be on STBY or ON). If the radar system is not in ON or STBY prior to transfer, a time-in period of four to five minutes is required for system operating after the system is ON.
- When the front pilot takes over AFCS operation from the rear pilot or vice versa he cannot engage any AFCS mode except STAB-AUG until the FLIGHT take-over button is engaged. Engaging the FLIGHT take-over button disengages all AFCS modes except STAB-AUG.
- Due to a system interlock the NAV take-over button cannot be engaged unless the heading-reference switch on the Doppler control panel in the cockpit taking over control is at MAG or DG.

- When NAV control is transferred from one cockpit to the other, the HSI compass cards in either or both cockpits may fluctuate and/or oscillate. The amount of fluctuation and/or oscillation will vary and depends on flight conditions, system tolerance, and synchronizing error. A heading change may occur when the fluctuations and/or oscillations end. To minimize the heading change on the HSI compass cards during NAV transfer, the sync button should be depressed during straight and level flight and the synchronizing indicator needle approximately centered prior to depressing the NAV button. This will prevent a heading change on the HSI compass cards from exceeding two degrees. The change error will be removed automatically by the slow slave system (1½-2 degrees per minute) and the HSI compass cards should return to the proper heading.

When a control transfer button is depressed, the control functions of the selected system are transferred to the cockpit in which the button was depressed. The corresponding button in the other cockpit will disengage (if previously engaged) and then illuminate indicating the other cockpit has control. Refer to Indicator Lights in the next paragraph for details of the indicating system. The control panels and/or systems controlled when the control transfer buttons are engaged, are as follows:

<i>Button Placard</i>	<i>System(s) Controlled</i>
FLIGHT	Automatic Flight Control System (AFCS) — Instrument Landing System (ILS) — Instrument Mode Selector Switch — Steering Needle Switch

NOTES:

1. All AFCS junctions except STAB AUG are disengaged during take-over. Pilot relief mode must be reengaged in cockpit with control.
2. ILS control must never be transferred on glide slope in AILS or erratic AFCS performance may result during transfer.
3. If the instrument selector switch in the cockpit taking over is not compatible with the system operating (ILS, TACAN, DOPPLER, etc.), the marker beacon lights

and identification signals (if applicable) and the applicable instrument displays in both cockpits will be unreliable.

4. If flying an ILS localizer beam, the ILS junction switch should be ON in the cockpit taking over before engaging the FLIGHT take-over button.

NAV Doppler and Compass Systems

NOTES:

1. Display ground speed, drift angle, course, track and latitude and longitude is continuous in both cockpits regardless of which cockpit has control.
2. Display of heading on HSI and sync error on the compass control panel is continuous regardless of cockpit in control; however, the compass function selector switches in both cockpits must be at SLAVED for sync error to be displayed.
3. If AFCS pilot relief mode is engaged and the function selector switch in the cockpit taking over is at SLAVED, the pilot relief mode will disengage when take-over occurs. If the function selector switch is at DC, pilot relief will not disengage.

TACAN TACAN Navigation System

NOTE:

If the controls of the cockpit taking over are not compatible with the other cockpit when flying a specific TACAN beacon, the continuity of navigation information is lost.

COMM UHF Command Radio

WEAPONS *Weapons Selector Switch,
*Bomb Mode Selector Switch,
Range Wind Potentiometer and
MANUAL/AUTO Switch,
*Pylon Sequence Selector
Switch, Six Station Selection
Buttons, Master Armament
Switch, Freeze/Fire Button.

NOTE:

*In the rear cockpit only, those switches and switch positions applicable to training in radar bombing with practice type special stores are active and on a "take-over" all others are dummies or electrically deactivated. The active positions are: weapon selector switch, SPL

WPN; bomb mode selector switch, all positions; pylon sequence selector, SINGLE ONLY and OFF

RADAR R-14 Search and Range Radar Set

Control Transfer Indicator Lights. [F]

The indicator lights on each control transfer panel (figure 1-62) are legend type lights displaying NO CONTROL when illuminated and are powered by AC primary power. An indicator light will illuminate on each button when the cockpit is not in command of the control function for that take-over button. Brightness of the indicator lights in each cockpit can be controlled by use of the FLIGHT INST light control in that cockpit. If a control transfer button is illuminated, depressing the button will cause the light to go out (if the button remains engaged); however, the corresponding button in the other cockpit will pop up and its indicator light will illuminate.

Note

Illumination of the NO CONTROL legend light in a take-over button is the only indication of what cockpit does not have control of a system's functions. Regardless of the button position if the NO CONTROL light is not illuminated the cockpit has control of the system. When an aft cockpit take-over button is depressed and the button does not remain engaged and the NO CONTROL light illuminates, this indicates a malfunction in the button's transfer circuit and control can only be exercised in the front cockpit. If a rear or front cockpit transfer button is depressed and the button does not remain engaged but the NO CONTROL light goes out, this indicates the holding solenoid of the button is defective but the cockpit has control of this selected function.

Control Transfer Lamp Test Button. [F]

The lamp test button in each cockpit (figure 1-62) is a spring-loaded-to-off pushbutton switch placarded TEST LAMPS and is powered by AC primary power. Depressing and holding the button results in all six take-over button indicator lights in that cockpit illuminating. When the button is released the indicator lights will go out.

ESCAPE SYSTEM.

The escape system extends the maximum and minimum airspeed and altitudes at which escape may be successfully accomplished, and requires a minimum of effort on the part of the pilot (either crew member on [F] aircraft). In all cases of emergency exit in flight, it is recommended that escape is accomplished by means of the jettisonable canopy, the ejection seat with automatic personal disconnects, survival kit, automatic opening safety belt, seat-man separator, and the automatic parachute.

The [F] aircraft has two canopies and two seats, and a bail out switch in each cockpit to permit the aircraft commander (whether in aft or forward cockpit) to illuminate a warning light ordering escape (or ejection procedures) when voice communication is not possible.

Note

[F] On aircraft [F-542]N/C/W the escape systems in each cockpit are complete and separate systems. Each crew member controls his own canopy jettison and seat ejection systems.

[F] • On aircraft [F-542]C/W the escape systems for the forward and aft cockpits are ballistically interconnected to provide automatic aft canopy jettison and seat ejection when ejection procedures are initiated from the forward cockpit. The aft crew member can, however, control the independent aft canopy jettison and seat ejection system when escape procedures are initiated from the aft cockpit.

The components and functions of the escape system are explained in subsequent paragraphs under appropriate headings.

ESCAPE SYSTEM FUNCTIONS

[F-542] N/C/W

Leg Braces

[F-542] N/C/W

■ The leg braces on the ejection seat (11, figure 1-64) are interconnected by a common pivot shaft and can be raised by either or both hands. Raising the leg braces causes the following events to occur:

- Both armrests are moved to the raised position.

- The shoulder harness control handle is moved to the locked position.
- The ejection trigger in each leg brace is moved to the cocked position, arming the seat for ejection.

Seat Ejection

[1038] C/W [F-542] N/C/W

The ejection triggers on the ejection seat (12, figure 1-64) are connected to individual initiators. Actuating either or both ejection triggers causes the following to occur:

- Canopy locks are opened, the canopy is opened and separated from the aircraft. Three tenths of a second later the seat is ejected.
- With the IFF Master switch in LOW or NORM and nose gear up and locked, the EMERGENCY IFF mode will be actuated automatically when the canopy is jettisoned.
- All aircraft to seat or survival kit connections are disconnected.
- The automatic safety belt initiator (incorporating a one second time delay) is actuated.
- The chaff dispenser box is opened.
- After the seat has left the cockpit, the safety belt initiator fires, opening the safety belt, actuating the seat man separator, the parachute deployment gun actuator and the seat retardation parachute system. The open safety belt releases the shoulder harness straps and on aircraft [1083]C/W releases the leg lanyards
- The parachute firing cable arms the deployment gun and is disconnected from the parachute deployment gun actuator.
- The seat man separator strap assembly is drawn taut, displacing the survival kit and the pilot from the seat, and arms the raft inflating system.
- If the parachute is below an altitude of 15,500 feet, the firing pin in the deployment gun is released, initiating a one second time delay cartridge in the deployment gun.

- If the parachute is above an altitude of 15,500 feet, the firing pin in the deployment gun is held in the cocked position until the aneroid device senses that the 15,500 foot altitude has been reached.

WARNING

During the freefall resulting from an ejection above 15,500 feet, every effort should be made to keep hands and arms away from the line of fire of the parachute deployment gun.

- The parachute is force-deployed.

After the parachute is open, when the survival kit emergency release handle (figure 1-68) is actuated the following will occur:

- The kit container is separated from the crew-member.
- The life raft will inflate.
- The kit will release the straps connecting it to the parachute harness and fall away from the crew-member but will be retained by a 25-foot drop line.

Seat Ejection

[1038] N/C/W [F-542] N/C/W

The ejection triggers on the ejection seat (12, figure 1-64) are connected to individual initiators. Actuating either or both ejection triggers causes the following to occur:

- Canopy locks are opened, the canopy is opened and separated from the aircraft. Three tenths of a second later the seat is ejected.
- With the IFF Master switch in LOW or NORM and nose gear up and locked, the EMERGENCY IFF mode will be actuated automatically when the canopy is jettisoned.
- All aircraft to seat or survival kit connections are disconnected.
- The automatic safety belt initiator (incorporating a one second time delay) is actuated.

- The chaff dispenser box is opened.
- After the seat has left the cockpit, the safety belt initiator fires, opening the safety belt, actuating the seat man separator and on aircraft [1047] C/W releases the seat retardation chute.
- The open safety belt releases the shoulder harness straps but retains the parachute lanyard and on aircraft [1083] C/W releases the leg lanyards.
- The seat man separator strap assembly is drawn taut displacing the survival kit and pilot from the seat, and arms the raft inflation system.
- As the pilot is separated from the seat, the parachute timer lanyard, still connected to the left half of the safety belt, will actuate the parachute timer. If above 14,000 feet, the timer will delay parachute deployment until 14,000 feet is reached, if below 14,000 feet the timer will deploy the parachute in one second. If, however, the zero delay lanyard is connected to the rip cord grip, it will override the time and deploy the parachute immediately.

After the parachute is open, when the survival kit emergency release handle (figure 1-68) is actuated the following will occur:

- The kit container is separated from the crew-member.
- The life raft will inflate.
- The kit will release the straps connecting it to the parachute harness and fall away from the crew-member but will be retained by a 25 foot drop line.

ESCAPE SYSTEM FUNCTIONS [F-542] C/W

Ejection Initiated from Forward Cockpit [F-542] C/W

The leg braces on the ejection seat (13, figure 1-64) are interconnected by a common pivot shaft and can be raised by either or both hands. Raising the leg braces causes the following events to occur:

- Both arm rests are moved to the raised position. (Front Cockpit.)
- The shoulder harness control handle is moved to the locked position (Front Cockpit).

- The ejection trigger in each leg brace is moved to the cocked position, arming the seat for ejection (Front Cockpit).

The ejection triggers on the ejection seat (12, figure 1-64) are connected to individual initiators. Actuating either or both ejection triggers causes the following to occur:

- The powered inertia reel on the aft seat is fired, positioning the occupant in the ejection position.
- The aft canopy locks are opened, the canopy is opened and separated from the aircraft.
- With the IFF master switch in LOW or NORM and nose gear up and locked, the EMERGENCY IFF mode will be actuated automatically when the canopy is jettisoned.
- The aft seat is ejected.
- The forward canopy locks are opened, the canopy is opened and separated from the aircraft.
- The forward seat is ejected.

After Seat Ejection

[1038] C/W [F-542] C/W

- All aircraft to seat or survival kit connections are disconnected.
- The automatic safety belt initiator (incorporating a one second time delay) is actuated.
- The chaff dispenser box is opened.
- After the seat has left the cockpit, the safety belt initiator fires, opening the safety belt, actuating the seat man separator, the parachute deployment gun actuator and the seat retardation parachute system. The open safety belt releases the shoulder harness straps and on aircraft [1083] C/W releases the leg lanyards.
- The parachute firing cable arms the deployment gun and is disconnected from the parachute deployment gun actuator.
- The seat man separator strap assembly is drawn taut, displacing the survival kit and the pilot from the seat, and arms the raft inflating system.
- If the parachute is below an altitude of 15,500 feet, the firing pin in the deployment gun is released, initiating a one second time delay cartridge in the deployment gun.

- If the parachute is above an altitude of 15,500 feet, the firing pin in the deployment gun is held in the cocked position until the aneroid device senses that the 15,500 foot altitude has been reached.

WARNING

During the freefall resulting from an ejection above 15,500 feet, every effort should be made to keep hands and arms away from the line of fire of the parachute deployment gun.

- The parachute is force-deployed.

After the parachute is open, when the survival kit emergency release handle (figure 1-68) is actuated the following will occur:

- The kit container is separated from the crew-member.
- The life raft will inflate.
- The kit will release the straps connecting it to the parachute harness and fall away from the crew-member but will be retained by a 25-foot drop line.

After Seat Ejection

[1038] N/C/W [F-542] C/W

- All aircraft to seat or survival kit connections are disconnected.
- The automatic safety belt initiator (incorporating a one second time delay) is actuated.
- The chaff dispenser box is opened.
- After the seat has left the cockpit, the safety belt initiator fires, opening the safety belt, actuating the seat man separator and on aircraft [1047] C/W releases the seat radiation chute.
- The open safety belt releases the shoulder harness straps but retains the parachute lanyard and on aircraft [1083] C/W releases the leg lanyards.
- The seat man separator strap assembly is drawn taut displacing the survival kit and pilot from the seat, and arms the raft inflation system.
- As the pilot is separated from the seat, the parachute timer lanyard, still connected to the left half of the safety belt, will actuate the parachute timer. If above 14,000 feet,

the timer will delay parachute deployment until 14,000 feet is reached, if below 14,000 feet the timer will deploy the parachute in one second. If, however, the zero delay lanyard is connected to the rip cord grip, it will override the time and deploy the parachute immediately.

After the parachute is open, when the survival kit emergency release handle (figure 1-68) is actuated the following will occur:

- The kit container is separated from the crew-member.
- The life raft will inflate.
- The kit will release the straps connecting it to the parachute harness and fall away from the crew-member but will be retained by a 25 foot drop line.

The ejection triggers on the ejection seat (10, figure 1-64) are connected to individual initiators. Actuating either or both triggers cause the following events to occur:

1. The powered inertia reel on the aft seat is fired, positioning the occupant in the ejection position.
2. Aft canopy locks are opened, the canopy is opened and separated from the aircraft.
3. The aft seat is ejected.
4. Fwd canopy locks are opened, the canopy is opened and separated from the aircraft.
5. The forward seat is ejected.

BAIL-OUT WARNING SYSTEM. [F]

A bail-out warning system is incorporated to permit the aircraft commander (whether in forward or aft cockpit) to command aircraft abandonment when conditions warrant this and voice communication is not possible.

BAIL-OUT LIGHT SWITCH. [F]

The bail-out light switch (12, figure 1-6) is a two-position guarded switch placarded BAIL-OUT and is powered by battery power. The switches are guarded in the down (OFF) position and when the guard of either switch is lifted and the switch moved up to the BAIL-OUT position a red light on the instrument panel of both cockpits illuminates displaying BAIL-OUT.

CANOPY.

The canopy is a clam-shell type and made up of two plastic panels with an intervening air space. Dry air fills the space between the two layers to prevent canopy fog. This dry air is not circulated but is free to move in and out of both canopies dependent upon pressure in the cockpit. In the closed position, the canopy is sealed to the cockpit structure by a rubber tube which is automatically inflated by air pressure from the engine compressor. The canopy is hinged to the fuselage and, when opened, moves up and aft in an arc to clear the pilot. The canopy is normally opened and closed by means of the electrical actuator portion of the integral actuator remover assembly which is energized

directly from the battery bus. The canopy remover (explosive charge) portion of the integral actuator remover jettisons the canopy from the aircraft. To open the canopy, without electrical power, the electric actuator is disengaged by an internal or external control. Emergency canopy removal is accomplished by internally or externally controlled initiators that develop a high pneumatic pressure and actuate a thruster and the canopy remover. The thruster through a self-contained explosive charge, releases the downlocks, while the remover jettisons the canopy.

WARNING

If the canopy is not fully closed (CANOPY OPEN light will be illuminated), it is possible it will not jettison. Therefore other means would have to be taken to effect egress from the aircraft; i.e., manually or by cutting through the plastic panels.

- Ⓛ • If the canopies are closed but the CANOPY OPEN light in each cockpit is illuminated, it is possible that either or both of the canopies will not separate from the aircraft when jettisoned. This may occur as the light circuit and separation (shearing of the canopy retainer) of the canopy depends on the position of the jettison safety lock linkage bellcrank against the canopy retainer lug.

CAUTION

Refer to canopy limitations during taxiing in section V.

- Keep arms clear of canopy rails during taxiing.

CANOPY CONTROLS.

Interior Canopy Lock Lever.

The interior canopy lock lever (figure 1-63) is placarded CANOPY RELEASE and is spring-loaded to the aft position to prevent interference

with the pilot. To open the canopy, the lock lever is rotated forward then raised upward. This operation unlocks the canopy and closes the canopy safety interlock switch making power available to the interior and exterior canopy control switches. To lock the canopy in the down position, the interior canopy lock lever is rotated downward. The canopy lock lever will then automatically rotate to the aft position.

CAUTION

Moving the canopy lock lever to the locked position moves the canopy locking hooks over the locking rollers (interior, left and right sides of the canopy rails). The position of the hooks over the rollers is the only positive indication in the cockpit that the canopy is locked. Since these hooks and rollers are visible and accessible to the pilot they should be used as the primary check that the canopy is locked.

Exterior Canopy Lock Lever.

The exterior canopy lock levers (figure 1-63) provided on both sides of the fuselage are flush mounted. The upper end of the lock lever is pushed in until the lever can be grasped and raised upward. This operation unlocks the canopy and closes the safety interlock switch making power available to the interior and exterior canopy control switches. To lock the canopy in the down position, the exterior canopy lock lever is rotated downward until flush with the fuselage skin.

Interior Canopy Control Switch.

The interior canopy control switch (figure 1-63) placarded CANOPY, is located above the left hand console area, and has two spring loaded positions placarded OPEN and CLOSE, and an unmarked neutral or OFF position. Battery power is supplied to the canopy actuator when the interior canopy control switch is placed in the OPEN or CLOSE position to move the canopy as required. The canopy can be opened or closed or stopped in any intermediate position, regardless of battery switch position.

Note

The canopy can be stopped at any intermediate position by releasing the respective

CANOPY CONTROLS

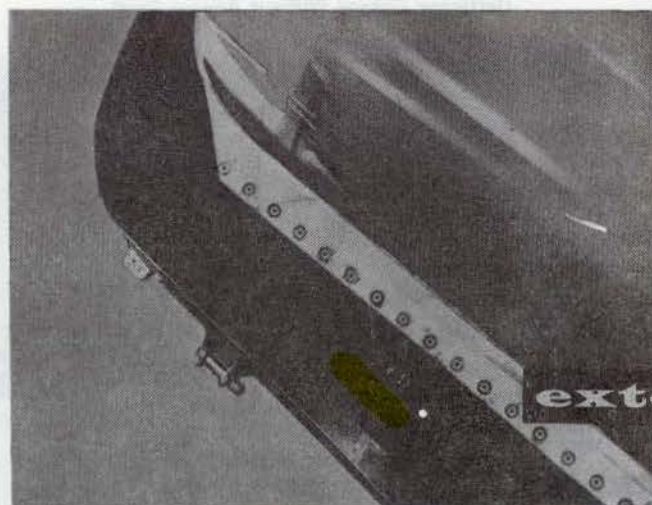
TYPICAL



CANOPY LOCK LEVER



CANOPY CONTROL SWITCH

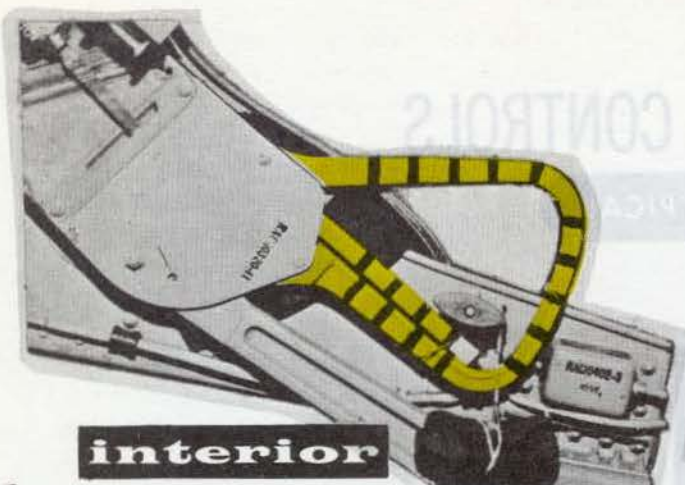


CANOPY LIFT



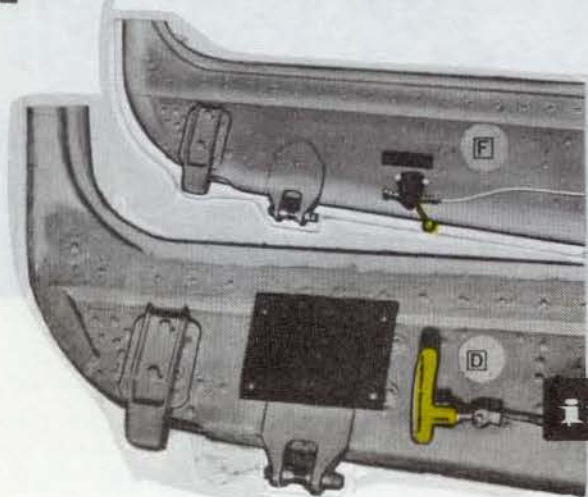
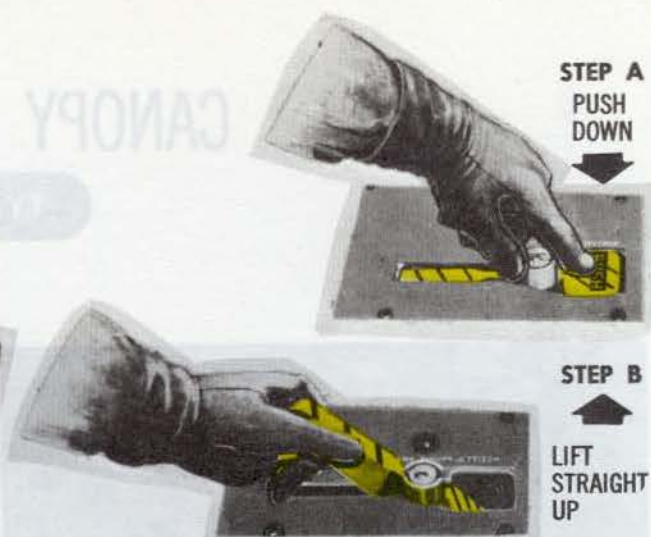
CANOPY LOCK LEVER
and CONTROL BUTTONS

Figure 1-63 (Sheet 1 of 2)



interior

LEG BRACE (EJECTION SYSTEM ARMING CONTROL)
(Left and Right Side of Seat) (Arms Ejection System)



CANOPY ACTUATOR RELEASE HANDLE
Releases Canopy Actuator
to Permit Manual Opening

**CANOPY ELECTRIC
ACTUATOR DISENGAGE**



AUXILIARY CANOPY JETTISON HANDLE
(Jettisons Canopy Without Arming Seat)



CANOPY ACTUATOR RELEASE BUTTON
Releases Canopy Actuator
to Permit Manual Opening

exterior



CANOPY JETTISON HANDLE
Jettisons Canopy Without Arming Seat

Figure 1-63 (Sheet 2 of 2)

Note (Continued)

interior canopy control switch. The canopy actuator limit switch will bring the canopy to a stop in the fully opened position. When closing the canopy the actuator clutch will slip before the close limit switch is reached. Therefore, if the switch is held in the CLOSE position after the canopy is fully closed, a clicking noise from the actuator will be heard. The control switch should be released at first indication of this condition.

Exterior Canopy Control Buttons.

Two exterior canopy control buttons (figure 1-63), located on the forward side of the exterior canopy lock lever well, are accessible only when the lock levers are raised. The buttons are spring-loaded to the OFF position, and encased in rubber seals to effect cockpit sealing. The upper button on either side is used for opening the canopy, and the lower one for closing it. Battery bus power is supplied to the canopy actuator when either button is depressed, and the canopy can be opened or closed regardless of battery switch position.

Note

The canopy can be stopped at any intermediate position by releasing the exterior canopy control buttons. The canopy actuator limit switch will bring the canopy to a stop in the fully opened position. When closing the canopy the actuator clutch will slip before the close limit switch is reached. Therefore, if the button is held in the closed position after the canopy is fully closed, a clicking noise from the actuator will be heard. The control button should be released at first indication of this condition.

Interior Canopy Actuator Release Handle.

A handle (figure 1-63) on the right canopy skirt is provided to insure the opening of the canopy in the event of battery power or electric actuator failure. For normal canopy operation in the [F] the handle must be in the aft position with a pip-pin installed through it to assure the electric actuator is mechanically connected to the canopy. To mechanically release the electrical actuator so that canopy can be unlocked and raised manually, the handle pip-pin must be pulled out and the handle pushed forward. A T-handle on the right canopy

skirt in the [D], placarded CANOPY RELEASE, when pulled, will mechanically release the electric actuator so that the canopy may be unlocked and raised manually.

CAUTION

- [F] To prevent shearing the canopy hinge retainer rivets or elongating the rivet holes when manually opening the canopy, partially raise the canopy and hold the disconnected actuator forward, then raise the canopy to 90 degrees.
- [F] • To secure the canopy in the 90 degree position, engage the ball-lock pin (located on the aft canopy frame) from inside the canopy hinge outboard into the hinge support structure.
- [D] • Canopy uplocks are not provided; therefore, if the canopy is opened manually it must be held open.

Exterior Canopy Actuator Release Button.

A button located on the top aft end of the canopy (figure 1-63) is provided to insure the opening of the canopy in the event of battery power or electric actuator failure. Depressing the button will mechanically release the electric canopy actuator so that the canopy may be unlocked and raised manually.

CAUTION

- [F] To prevent shearing the canopy hinge retainer rivets or elongating the rivet holes when manually opening the canopy, partially raise the canopy and move the disconnected actuator forward then raise the canopy to 90 degrees.
- [F] • To secure the canopy in the 90 degree position, engage the ball-lock pin (located in the aft canopy frame) from inside the canopy hinge outboard into the hinge support structure.
- [D] • Canopy uplocks are not provided; therefore, if the canopy is opened manually it must be held open.

Leg Brace.

The right and left leg brace (figure 1-63) on the pilot's seat are interconnected and raised simultaneously. When the leg braces are raised the shoulder harness inertia reel is locked and the armrests are raised to the horizontal position. The trigger on each leg brace is then cocked for canopy jettison and seat ejection. A safety pin, with a red streamer attached, is inserted in the right leg brace to prevent inadvertent actuation of the leg brace during ground operation. This safety pin is removed before flight by the pilot and stowed in a flight status safety pin pouch above the right console in the front cockpit and in a container in the aft end of the right console in the rear cockpit.

Auxiliary Canopy Jettison Handle.

The auxiliary canopy jettison handle (figure 1-63) permits jettisoning the canopy without arming the ejection seat. A handle is installed flush on the top aft end of the left console and is painted yellow with black diagonal stripes. The forward end, placarded PUSH, must be depressed so as to rotate the lever which then exposes the auxiliary canopy jettison handle. The handle is then pulled straight up (approximately one inch) to jettison the canopy. Actuating the handle detonates an initiator which generates gas pressure to unlock the canopy and ignite the canopy remover portion of the integral actuator/remover which separates the canopy from the aircraft. Jettisoning the canopy in this manner eliminates the danger of ejecting the seat, as the leg braces are still in the down position and the ejection triggers are not cocked for firing. A safety pin with a red streamer attached is provided to prevent inadvertent operation. This safety pin, if installed, is removed before flight and stowed in a flight status safety pin pouch above the right console and in the [E] rear cockpit in a container in the aft end of the right console.

Exterior Canopy Jettison Handle.

An external system for jettisoning the canopy by ground personnel during an emergency includes an exterior canopy jettison handle (figure 1-63) attached to six feet of cable and secured by clips in a compartment on the left fuselage below the canopy. Canopy jettison is effected by opening the access door, grasping the handle and pulling it to the full length of the cable. With the cable fully extended, an initiator is detonated and the resulting gas generated activates a thruster which unlocks both canopies then fires the canopy remover which

disconnects the electric actuator and separates the canopy from the aircraft in an up and aft direction. On [E] aircraft, approximately one second after the thruster is fired, the aft canopy remover is fired and operates in the same manner as the front canopy to separate the rear canopy from the aircraft.

Canopy Caution Light.

The canopy caution light (figure 1-60) on the caution light panel displays CANOPY OPEN when illuminated and is powered by DC primary power. Illumination of the light indicates the canopy is not locked or the canopy jettison safety switches are closed. Illumination of the light is controlled by the canopy lock switch, canopy position switch and canopy jettison safety switch in the cockpit. If any of the switches are not in the locked position the canopy warning and master caution light will illuminate. The light will illuminate together with the master caution light whenever the canopy is in any position other than closed and locked.

WARNING

[E] Either canopy jettison safety switch will cause both canopy warning lights to illuminate if the jettison safety lock linkage bellcrank is not against the canopy shear plate. This can occur even though both canopies are mechanically locked (hooks engaged by rollers). If either canopy is jettisoned with this condition the canopy may not shear and possible interfere with either or both seat ejections.

CAUTION

Moving the canopy lock lever to the locked position moves the canopy locking hooks over the locking rollers (interior, left and right sides of the canopy rails). The position of the hooks over the rollers is the only positive indication in the cockpit that the canopy is locked. Since these hooks and rollers are visible and accessible to either pilot they should be used as the primary check that the canopy is locked.

WINDSHIELD.

The windshield consists of three transparent panels. The center panel is laminated bullet resistant glass

with an electrical element incorporated between the laminations for defogging. Each side panel is made up of two plastic panels with an air space between them for defogging. A defroster system, provided with a shutoff, directs hot air from the engine compressor to a perforated tube which directs the air over the inside of each side panel.

WINDSCREEN (REAR COCKPIT). [F]

A transparent windscreen on either side of the rear main instrument panel between the front and rear cockpit protects the rear cockpit crewmember from windblast and air loads if the front canopy is jettisoned in flight.

EJECTION SEAT.

Each ejection seat (figure 1-64) is an upward ejection, type designed to eject the pilot clear of the aircraft in an emergency. Aircraft utilize a rocket catapult/actuator assembly for ejection. The catapult and the rocket catapult/actuator are attached to the rear of the seat and supplies the propelling force to eject the seat during an emergency. The catapult or the rocket catapult is fired by an initiator which develops a high pneumatic pressure that is directed to actuate the firing mechanism. The rocket catapult raises the ejection speed capability up to mach 1.0 and also provides low speed/low altitude escape capability. Recovery has been demonstrated at zero speed/zero altitude; however, this should not be used as standard operating criteria. Test results have shown that chute deployment is aided by any increase in forward speed and that a forward speed of approximately 85 KIAS at zero altitude is considered minimum to provide the desired margin of safety. The rocket catapult will project the seat to a height of 300 to 400 feet above the aircraft; therefore, ejection at zero altitude is possible if required. However, a zoom maneuver, when possible, to gain altitude before ejecting is still considered advisable since it will provide an additional margin of safety. The pilot can raise or lower the seat to accommodate his external vision requirements without changing the relationship of the ejection seat CG to the catapult rocket motor thrust line. To improve the ejection trajectory and stability, thereby extending the safe escape envelope, the existing leg plate has been reduced in area and a spring loaded drag plate has been added to each side of the pilot's headrest. The drag plates are extended when the seat is ejected thereby adding drag area above the CG of the ejected mass. The ejection sequence has been changed so that raising the leg brace does not

jettison the canopy. Raising the leg brace locks the shoulder harness inertia reel and the ejection trigger in each leg brace is cocked for firing. Each trigger is connected to an initiator. Squeezing either trigger fires the initiator which produces gas pressure to jettison the canopy and arm a delay initiator which will fire the rocket catapult to eject the seat three tenths of a second after the canopy is jettisoned. All seats incorporate the following features: an armor plated headrest; provisions for electrical adjustment of seat height, adjustable armrests; an automatic lap belt release system with accommodations for automatic parachute; a shoulder harness with multi-directional inertia reel; canopy jettison and seat ejection controls, a quick disconnect for the pilot's personal leads and on aircraft [1047] C/W a seat retardation chute. In addition aircraft [1038] C/W have a parachute actuator which triggers the firing of a deployment gun in the force-deployed parachute. Aircraft [1083] C/W are provided with a limb restraining system.

The seat is safetied, for ground operation, by a pin installed in the right leg brace which must be removed before flight. The ejection controls are designed to jettison the canopy before seat ejection. The seat bucket will accommodate the MC-1 cushion and a survival kit container. Utilizing the wrong seat cushions or kit, or too much cushioning material, may result in the following dangerous conditions:

- a. Incorrect positioning of the pilot in the seat; thus making it difficult for him to reach all controls, or to prevent full aft stick travel.
- b. A definite injury hazard is created as the thick, compressible mass allows several inches of upward seat travel before exerting a direct lifting force on its occupant. After this amount of travel, the seat has gathered such momentum that excessive impact is produced when the seat initially lifts the pilot, thereby increasing chances of spinal injury.
- c. Where a crash landing is made, the combined compression of the two items will permit the pilot to sink down far enough to loosen the shoulder straps thus allowing the pilot to slump forward. In this position, the impact may severely injure his back.
- d. The use of additional material under the pilot may raise him to such a height that his arms will not be held by the retainers on either armrest, thus subjecting them to injury because of possible flailing in the wind blast.

EJECTION SEAT

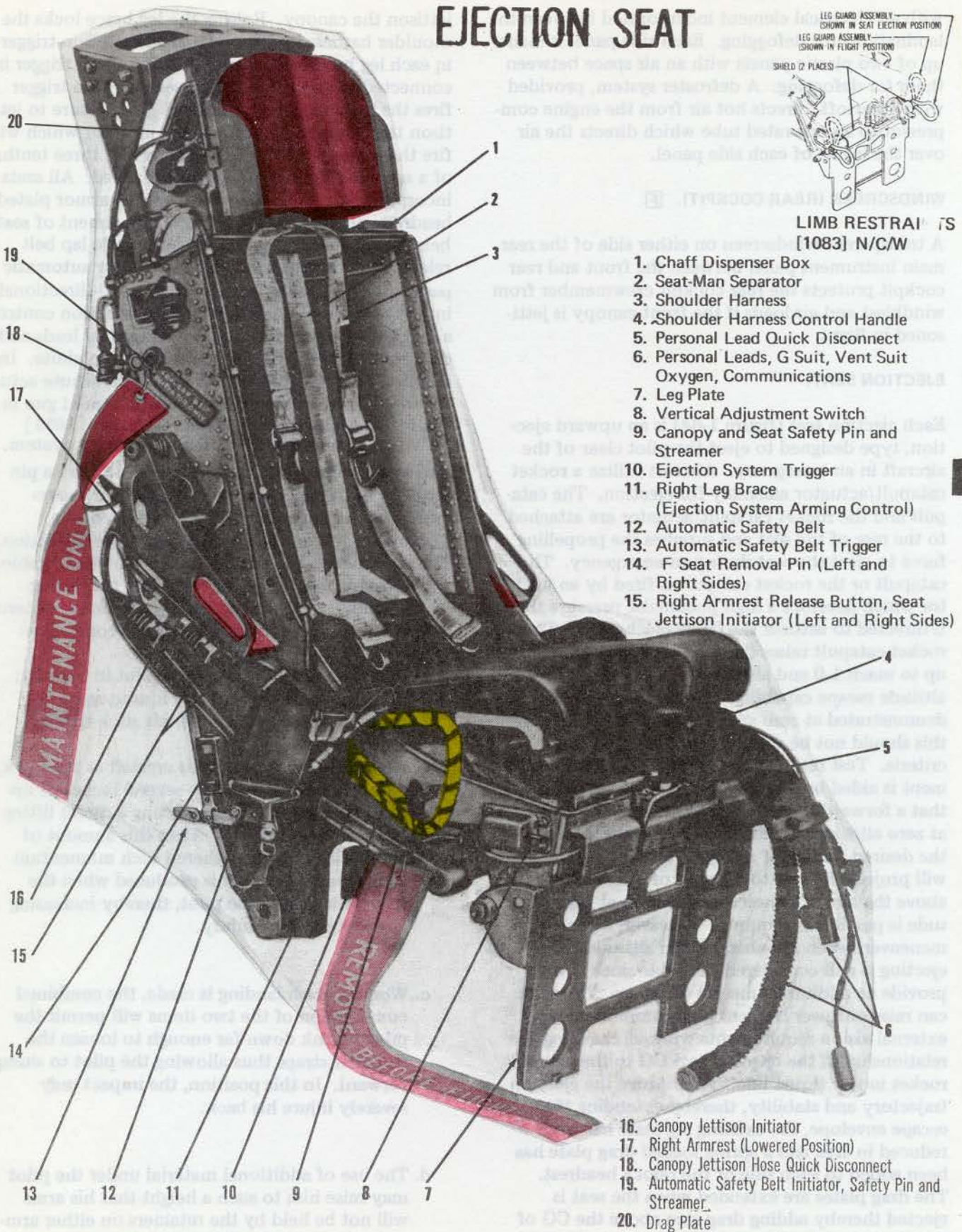


Figure 1-64

WARNING

Use of the Type C-2A one man life raft in conjunction with the contoured seat style survival kit container is not recommended because of the above reasons. This is also applicable to the Type C-2A one man life raft used in conjunction with the aircraft seat cushion.

Leg Brace.

The right and left leg braces (13, figure 1-64) on the ejection seat are interconnected to act simultaneously. Each brace incorporates a trigger (12, figure 1-64). In normal operation, the braces are folded down and secured (ground operation only) by a safety pin (11, figure 1-64) inserted in the right leg brace. This safety pin is removed before flight by the pilot, and stowed in a flight status safety pin pouch above the right console in the front cockpit and in a container in the aft end of the right console in the rear cockpit. When either or both leg braces are raised the shoulder harness inertia reel is locked and the armrests are raised to the horizontal position. When the leg braces are in the up position, a trigger in each leg brace is cocked for firing. Each trigger is connected to an initiator. Squeezing either trigger fires an initiator, producing gas pressure to jettison the canopy and arm a delay initiator which will fire the rocket catapult to eject the seat three tenths of a second after the canopy is jettisoned. Squeezing both triggers simultaneously will fire both initiators and improve canopy jettison and seat ejection reliability.

NOTE [F-542] C/W

- ☐ The escape systems for the forward and aft cockpits are ballistically interconnected to provide automatic aft canopy jettison and seat ejection when ejection procedures are initiated from the forward cockpit. The aft crew member can, however, control the independent aft canopy jettison and seat ejection system when escape procedures are initiated from the aft cockpit.

Limb Restraints.

[1083] N/C/W

The right and left hand limb restraints on the ejection seat are provided to contain the pilot's legs within a safe area to prevent injury during ejection from the aircraft. As the ejection seat leaves the

aircraft during ejection, the leg plate (9, figure 1-64) rotates down. As this rotation occurs, the leg plate pulls the pins which retain the limb restraints in the vertical (inflight) position and allows the spring-loaded restraints to rotate to the horizontal (or ejection) position.

Vertical Adjustment Switch.

The vertical adjustment switch (10, figure 1-64) on the ejection seat is a three-position type, spring-loaded to the OFF position. When the switch is moved to the UP position, DC secondary power is supplied to actuate an electric motor and screw jack mechanism to raise the seat. The self-locking drive mechanism will remain in any selected position when the switch is released. Placing the switch in the DOWN position lowers the seat. Over-all travel of the seat is 4¼ inches.

Shoulder Harness Control Handle.

A two-position LOCK-UNLOCKED shoulder harness control handle (4, figure 1-64) is located on the left side of the ejection seat. When the control handle is in the UNLOCKED position (full aft), the inertia reel harness cable will extend to allow the pilot to lean forward in the cockpit; however, the inertia reel harness cable will automatically lock whenever loads in excess of 2 to 3 G's are encountered. When the inertia reel is locked in this manner, it will remain locked until the control handle is moved to the LOCKED position and then returned to the UNLOCKED position. If the control handle is in the LOCKED position (full forward) while the pilot is leaning forward, the harness will retract with him as he straightens up, moving into successive locked positions, as he moves back against the seat. The LOCKED position is used when a crash landing is anticipated. This position provides an added safety precaution over that of the automatic safety lock. During the seat ejection sequence, a cam on the left leg brace positions the control handle to the locked position as soon as either leg brace is raised to jettison the canopy.

Note

The pilot is prevented from bending forward when the shoulder harness control handle is in the LOCKED position. Therefore all switches not readily accessible should be turned off prior to locking the shoulder harness.

Armrests.

The two armrests (19, figure 1-64) on the ejection seat may be raised to the horizontal position or lowered to afford better access to the console controls. An armrest release button (17, figure 1-64)

is provided beneath the front edge of the armrest. When the release button is depressed, the armrest locking mechanism is released which allows the armrests to be moved. Both armrests will move to the raised position when either leg brace is raised for canopy jettisoning.

Seat-Man Separator.

The ejection seat is equipped with a seat-man separator (2, figure 1-64) which operates automatically as a part of the seat ejection sequence and requires no additional effort on the part of the pilot. The system consists of a web strap assembly shaped like an inverted Y, and a cartridge operated actuator. Two straps attached to the forward edge of the bucket seat are routed under the survival kit to the yoke from which a single strap is routed up the face of the seat to the actuator behind the headrest. When each seat is ejected a trigger on the bottom of the seat is tripped, pulling a rod connected to the firing pin in an initiator. One second after the pin is pulled the cartridge is fired. High pressure gas from the cartridge is ported through flex lines to open the automatic safety belt and fire the cartridge in the seat-man separator actuator. The actuator draws the web strap assembly taut, effectively displacing the survival kit and separating the pilot from the seat. On aircraft [1038] N/C/W upon separation from the seat, the parachute lanyard, still attached to the open safety belt, actuates the parachute timer, or pulls the ripcord grip directly, if the zero delay lanyard is connected.

Chaff Dispenser.

An automatic chaff dispenser box (1, figure 1-64) is provided on the left side of the ejection seat. Upon seat ejection a mechanical linkage automatically opens the chaff dispenser and a leaf type spring ejects two chaff packages.

AUTOMATIC SAFETY BELT.

The ejection seat is equipped with a type MA-6 automatic opening safety belt (figure 1-66) which, in conjunction with the ejection seat and automatic escape system extending the maximum and minimum altitudes at which escape may be successfully accomplished. In a low altitude ejection, use of the automatic system greatly reduces the time required for separation from the seat and deployment of the parachute, and consequently reduces the altitude required for safe ejection. The automatic belt has been thoroughly tested and is completely reliable. No matter how fast a pilot's reactions are, he cannot beat the automatic operation; besides, he may not remain conscious during an actual ejection. The belt is cartridge operated for automatic opening during seat ejection, but manually for normal opening. Automatic operation is accomplished during seat ejection by gas pressure from a separate automatically controlled initiator which supplies pressure through a length of

high pressure hose that actuates a piston inside the belt, retracting the latch tongue, and releasing the belt swivel link. This gas pressure also releases the seat retardation chute on the aircraft [1047] C/W. The link accommodates an anchor [1038] N/C/W on a lanyard leading to the parachute automatic timer (figure 1-66). When the belt is manually opened, the anchor [1038] N/C/W is released automatically so that inadvertent actuation of the automatic parachute will not occur.

Automatic Operation.

Automatic belt opening and seat retardation chute release on aircraft [1047] C/W are accomplished as part of the seat ejection sequence and requires no additional effort on the part of the pilot. **UNDER NO CIRCUMSTANCES SHOULD THE BELT BE MANUALLY OPENED BEFORE EJECTION REGARDLESS OF ALTITUDE.** When the seat is ejected, the automatic safety belt trigger (13, figure 1-64) on the bottom of the seat is tripped, pulling a rod connected to the firing pin in the initiator. One second after the pin is pulled, the cartridge is fired. The time delay feature insures that the belt and the seat retardation chute will not release until the seat and pilot are entirely clear of the aircraft. When an automatic parachute is used, an anchor [1038] N/C/W attached to the parachute lanyard is installed over the lap belt swivel link. (See figure 1-66 for correct installation.) During automatic operation, the anchor [1038] N/C/W remains fixed in the release, providing an anchor [1038] N/C/W for the lanyard to the automatic rip cord release. Thus the automatic rip cord release is actuated as the pilot separates from his seat. The automatic opening safety belt should never be opened manually before ejection for the following reasons:

- a. If the belt is opened manually the escape operation is prolonged.
- b. Manual opening of the automatic safety belt creates a hazard to survival during uncontrollable flight. The opening of the safety belt during uncontrollable flight will mean that the pilot cannot stay in his seat before ejection if negative G is incurred.
- c. Manual opening of the automatic safety belt creates a hazard to survival if the pilot decides to crash land the aircraft. The pilot will probably not be able to fasten the safety belt and shoulder harness as he will be using both hands to control and crash land the aircraft.

INSTALLATION OF FORCE-DEPLOYED PARACHUTE

[1038] C/W

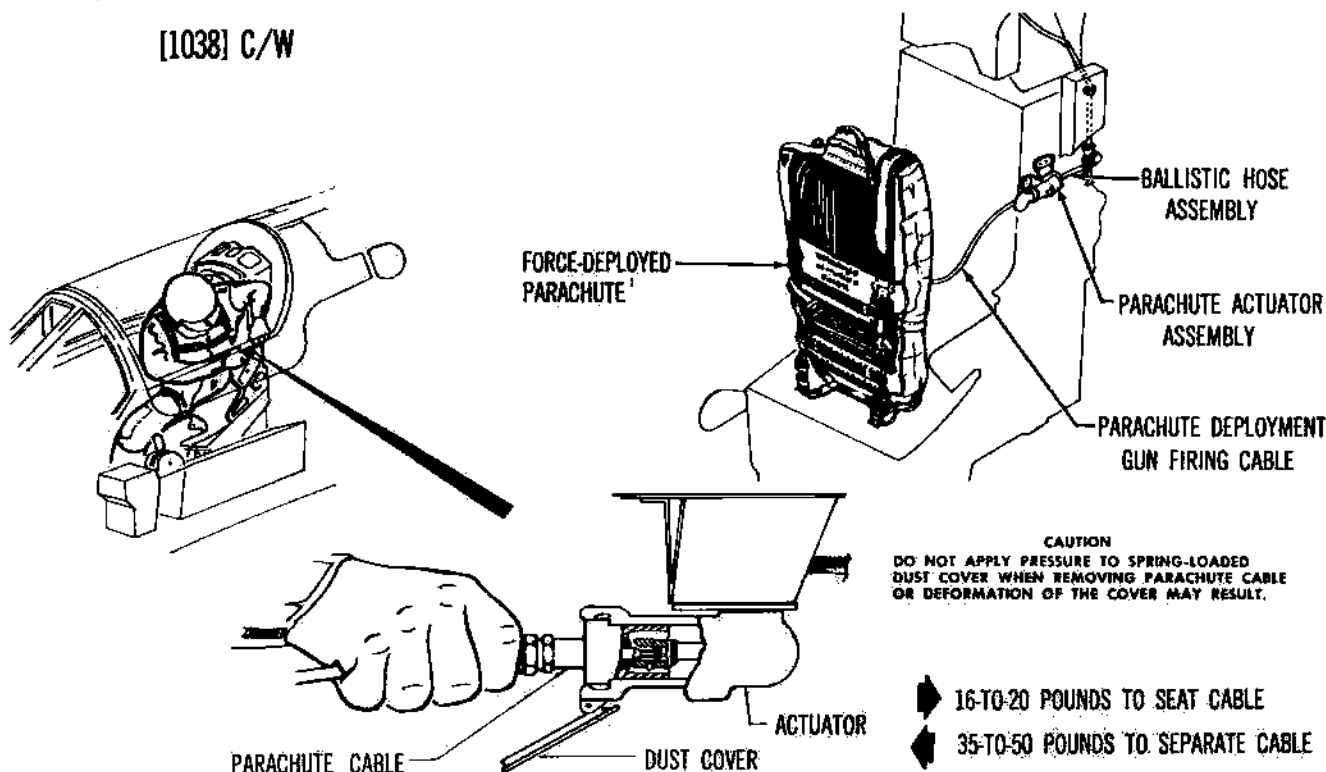


Figure 1-65

- d. The manual opening of the automatic safety belt will eliminate the automatic feature of the automatic opening parachute unless the pilot manually arms the parachute by pulling the arming ball [1038] N/C/W.
- e. Tail clearance is reduced by immediate separation of the pilot from the seat, which is likely to occur when the belt is opened before ejection.
- f. At high speeds the peak deceleration, due to air loads on the seat and pilot together, approaches the limits of human endurance. Since the deceleration of a pilot alone is considerably greater than that of the pilot and seat together, immediate separation at extremely high speeds could result in severe injury to the pilot.
- g. Immediate separation of the pilot and seat at extremely high speeds could result in inadvertent opening of the parachute due to the pack being blown open. In this event, fatal injuries will probably be incurred, because of the extremely high opening shock of parachute at this speed, or because of serious damage to the parachute itself upon opening at high speeds.

WARNING

Extreme caution should be taken to insure the Automatic Safety Belt Trigger (13, figure 1-64) which fires the escape system items on the seat is not fired inadvertently.

MANUAL OPERATION.

Refer to figure 1-65 and 1-66 for proper sequence of opening and closing the safety belt, shoulder harness, automatic parachute lanyard [1038] N/C/W, and connecting parachute firing cable [1038] C/W.

EJECTION SEAT RETARDATION SYSTEM [1047] C/W.

The ejection seat retardation system consists mainly of an eight foot retardation chute packed in a container mounted under the ejection seat. When the seat is ejected a firing pin in the automatic safety belt initiator is pulled. One second after the pin is pulled the initiator is fired developing a high pneumatic pressure which opens the automatic safety belt, fires the cartridge in the seat man separator and releases the retardation chute. The open chute slows the movement of the seat which in turn increases the distance between the seat and the pilot. This increased distance decreases the possibility of the seat interfering with the pilot.

AUTOMATIC SAFETY BELT **type MA-6**

OPEN (MANUALLY)

- 1 Automatic Release
- 2 Parachute Lanyard Anchor [1038] N/C/W
- 3 Swivel Link
- 4 Manual Release
- 5 Shoulder Harness Loops



WARNING

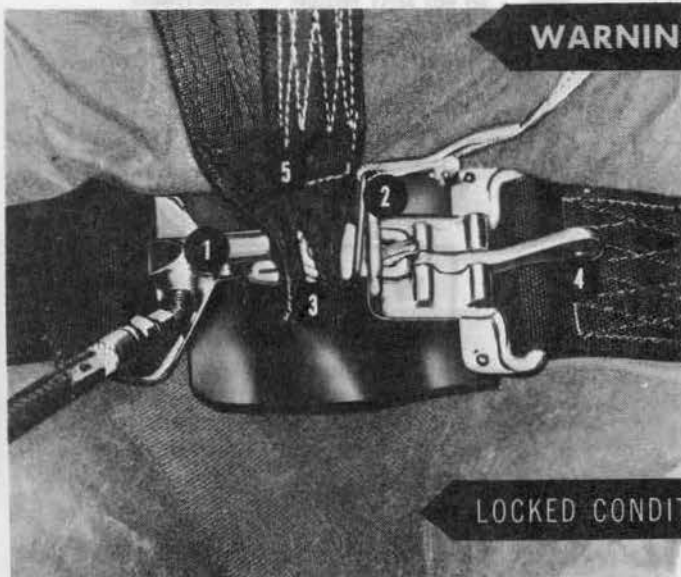
Failure to install the shoulder harness loops and parachute lanyard anchor [1038] N/C/W in correct sequence will prevent separation from the seat after ejection.

- a. Place right shoulder harness loop on safety belt swivel link.
- b. Place left shoulder harness loop on safety belt swivel link.
- c. Place parachute lanyard anchor on safety belt swivel link and fasten safety belt. [1038] N/C/W
- c-1. Fasten safety belt. Remove safety pin and dust cap from parachute firing cable and connect firing cable to parachute deployment gun actuator [1038] C/W.

WARNING

The force-deployed parachute contains a ballistically fired deployment gun. Extreme caution shall be exercised any time parachute is handled. Ensure that safety pin, streamer, and dust cap are always engaged in cable assembly to prevent deployment gun being discharged when cable assembly is not connected to actuator on ejection seat. Hold parachute so that barrel of deployment gun points away from all personnel and towards a suitable parapet in case of discharge.

WARNING



LOCKED CONDITION

- Swivel link 3 released from right side of belt.
 Shoulder harness loops 5 released from swivel link 3.
 Parachute lanyard anchor 2 [1038] N/C/W retained by shoulder on swivel link 3.
 Manual release lever 4 locked, holding swivel link to left side of belt.

AUTOMATICALLY OPENED

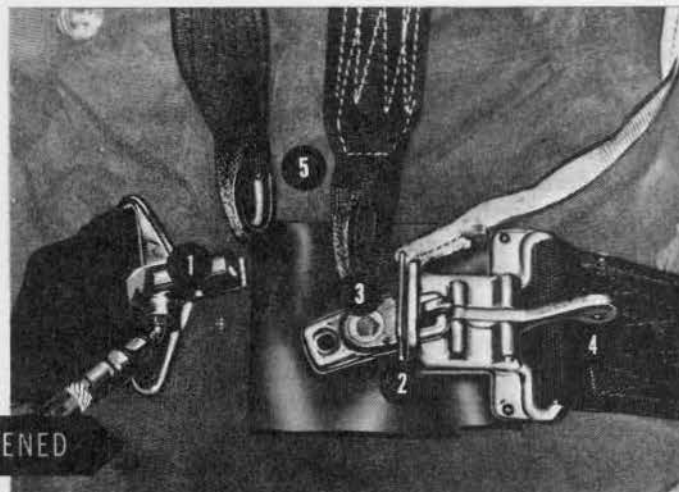


Figure 1-66

LIMB RESTRAINING SYSTEM [1083] C/W

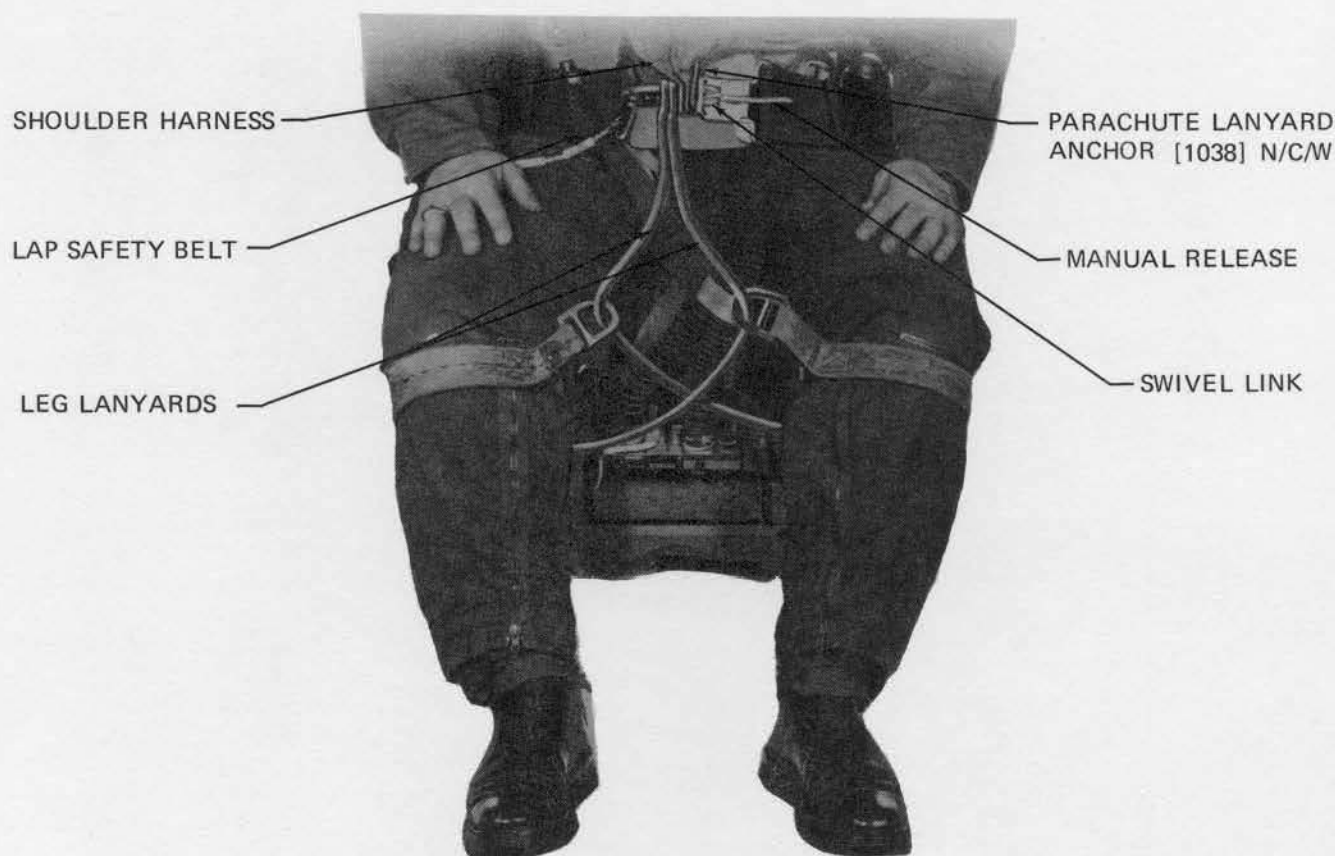


Figure 1-66A

LIMB RESTRAINING SYSTEM

[1083] C/W

A limb restraining system (figure 1-66A) is provided to prevent the pilot's legs from flailing during ejection. To utilize the system, the pilot must wear a garter type leg strap that accommodates a D-ring on each leg. Two lanyards are attached to the cockpit floor just aft of the ejection seat leg plate and routed so as to become exposed on the right and left forward-corners of the seat and are not attached to the survival kit. The lanyards are laced through the D-rings on the leg garters than attached to the automatic safety belt in the same manner as the shoulder harness. It will be noted that the lanyards cross, the left lanyard is laced through the right garter and the right lanyard is laced through the left garter. Upon ejection, as the seat rises, the lanyards

are drawn taut which pulls the pilot's legs together. When the seat is ejected, rivets attaching the lanyards to the cockpit floor are sheared. When the automatic safety belt opens the lanyards are released.

CAUTION

Connect the limb restraint lanyards then the shoulder harness lanyards to the MA-6 automatic lap belt in that order [1038] C/W. (Force deployed parachute.)

Connect the limb restraint lanyards, the shoulder harness lanyards and the parachute lanyard anchor to the MA-6 lap belt in that order [1038] N/C/W.

ZERO DELAY LANYARD for automatic parachute

[1038] N/C/W

WARNING

Refer to Section III for zero delay lanyard capabilities and limitations.

STOWAGE RING

Stow zero delay lanyard here for one second delay.

RIPCORD GRIP

Attach zero delay lanyard here for zero delay parachute deployment.

ZERO DELAY LANYARD HOOK



Figure 1-67

FORCE-DEPLOYED PARACHUTE [1038] C/W.

The force-deployed parachute extends the minimum altitudes at which escape may be successfully accomplished. In a high altitude ejection (above 15,500 feet), use of the force-deployed parachute avoids deployment of the parachute at an altitude where sufficient oxygen would not be available to permit safe parachute descent. The aneroid device in the parachute deployment gun will delay the firing of the deployment gun until the parachute falls free to a safe altitude. One second after reaching this safe altitude (below 15,500 feet), deployment will commence. By force-deploying the parachute, a filled canopy is achieved very rapidly. Aircraft speed will influence the time required to fill the force-deployed canopy. By force-deploying the parachute, safe ejection can be successfully accomplished on or very close to the ground (depending on the speed of the aircraft when ejection occurs). Refer to section III, Emergency Procedures, for detailed ejection information.

AUTOMATIC PARACHUTE [1038] N/C/W.

The automatic parachute extends the maximum and minimum altitudes at which escape may be successfully accomplished. In a high altitude ejection (above 14,000 feet) use of the automatic parachute avoids deployment of the parachute at an

altitude where sufficient oxygen would not be available to permit safe parachute descent. The aneroid action of the automatic parachute release will delay the opening of the parachute until the pilot falls free to a safe altitude. One second later parachute deployment will commence. For low altitude ejection, use of the zero delay lanyard will open the parachute immediately after separation from the seat.

Zero Delay Lanyard [1038] N/C/W.

To provide an improved low-altitude escape capability, a system incorporating a one second safety belt delay (M12 initiator) and a zero second parachute delay (one and zero system) is provided for ejection seat escape systems. This system makes use of a detachable lanyard, installed on the parachute harness (figure 1-67), that connects the parachute arming ball to the parachute rip cord grip. At very low altitudes and airspeeds, this zero delay lanyard must be connected, thus providing parachute actuation immediately after separation from the ejection seat. At other altitudes and airspeeds, the lanyard must be disconnected from the rip cord grip, thus allowing the parachute timer to actuate the parachute below the critical parachute opening speed, and below the parachute timer altitude setting. A ring, attached to the parachute harness is provided for stowage of the lanyard hook when it is not

SURVIVAL KIT

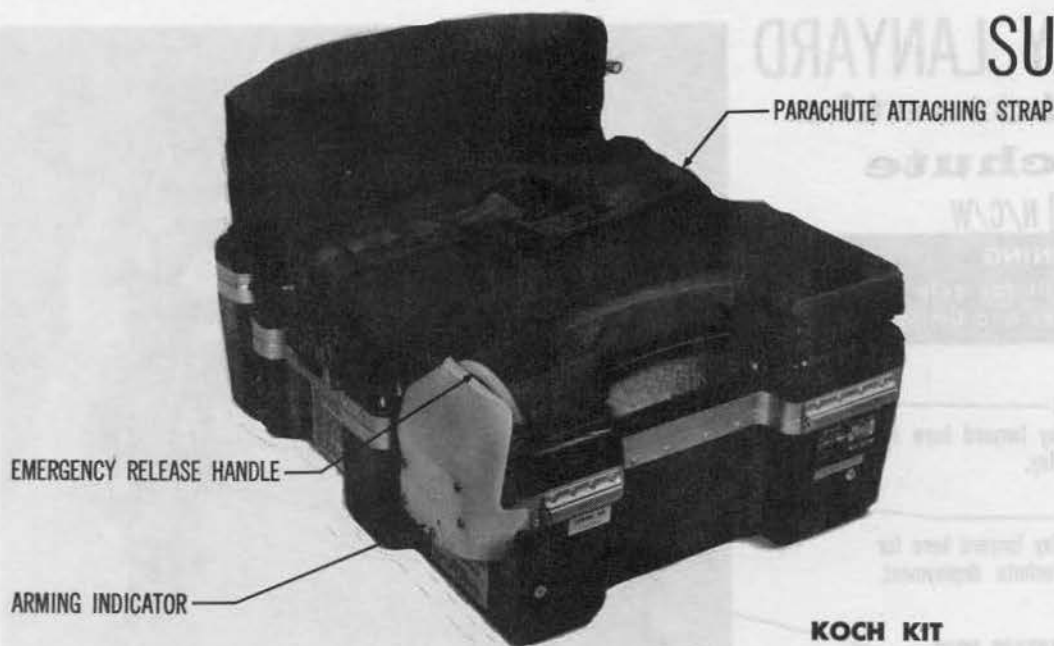


Figure 1-68

connected to the parachute rip cord grip. *This hooking and unhooking of the lanyard must be done manually by the pilot.*

WARNING

If the zero delay lanyard is left connected while flying at high altitude, and ejection becomes necessary, the aneroid feature of the parachute will be overridden, and the parachute will be deployed at an altitude where sufficient oxygen is not available to permit safe parachute descent.

- If the zero delay lanyard is left connected while flying at high speed and ejection becomes necessary, the time delay feature of the parachute will be overridden and the parachute will be deployed at high speed, resulting in an extremely high opening shock, in which case injuries will probably be incurred and the parachute seriously damaged.

- The frequency of seat/man/chute involvement is greatly increased with the zero delay lanyard connected. However, if a pilot knows he is going to eject above 2000 feet in a controlled situation, he should unhook the zero delay lanyard to reduce his chances of seat/man/chute involvement. On the other hand, under

any circumstances the pilot should not stop to connect the zero delay lanyard after deciding to eject. The resulting time loss outweighs any advantages which may be gained.

- If the automatic safety belt is opened manually, the parachute rip cord must be pulled manually.

Note

The low altitude capabilities and speed limitation of zero delay lanyard-parachute combinations are presented in section III.

SURVIVAL KIT.

The survival kit (figure 1-68) is designed to fit in the ejection seat and be used as a seat cushion with a back type parachute. The kit is made of fiberglass and fitted with a rubber cushion which is fastened to the lid with snaps and a zipper. Adjustable straps on each side attach the kit to the pilot's parachute harness. The kit contains a one-man life raft (if required), provision kit, and a reflector on back of the kit lid. The life raft (if installed) is inflated by an automatically actuated carbon dioxide bottle mounted on the inside of the survival kit. The provision kit is a waterproof packet strapped into the bottom of the survival kit and will accommodate the items necessary for survival in the area of operation.

Survival Kit Tie Down. [F]

The survival kit can be secured for solo flights by use of nylon tie down ropes. The ropes are secured to the cockpit floor and to the safety belt. If necessary, the seat may be adjusted to apply the proper tension on these ropes. In the event that the tie down ropes are not available, the kit should be removed from the aircraft.

WARNING

An improperly secured survival kit could become separated from the seat and become wedged between the seat and the control stick.

Survival Kit Emergency Release Handle.

The yellow survival kit emergency release handle (figure 1-68) is located on the right-hand side of the survival kit and is placarded EMERGENCY RELEASE. The handle is hinged at the rear and, when raised after ejection, will cause the following to occur simultaneously:

- Release the straps connecting the kit to the parachute.
- Actuate the carbon dioxide bottle for life raft inflation.

When released, the kit will fall away from the pilot and remain attached by means of a nylon lanyard (approximately 25 feet long) attached to the left-hand parachute attaching strap. The life raft and kit will remain attached through the descent and will strike the surface approximately 25 feet ahead of the pilot. The emergency release handle should be raised and the kit released, during the descent after parachute deployment, and after the pilot has descended to an altitude not requiring oxygen.

WARNING

Do not raise the emergency release handle during descent until after parachute deployment to prevent the kit or the lanyard from fouling the parachute and to prevent over inflation with possible rupture of the life raft.

The emergency release handle may be used when an emergency escape other than ejection is required, such as escape from the aircraft after a crash landing. Raising the handle, when the seat has not been ejected, releases the left and right harness wedge connectors from the survival kit. The kit lid is also opened.

WARNING

On aircraft [966] the pilot will be attached to the aircraft when the survival kit is connected to the parachute even though the leg lanyards are not utilized.

- Prior to emergency ground evacuation, be sure that the bottom of the survival kit is in contact with the seat (arming pin depressed) before pulling the emergency release handle. This action opens the kit lid and releases the parachute attaching straps. If the kit is lifted approximately one inch (arming pin extended) before the emergency release handle is pulled, the kit lid opens, the parachute attaching straps are released and the life raft (if installed) will inflate.

HEATING, PRESSURIZATION AND REFRIGERATION SYSTEM.**Note**

- [F] All switches and controls for the heating, ventilation, pressurization and refrigeration systems are in the front cockpit except the fuel tank selector switch, ventilated suit flow control valve and the anti-G-suit valve which are in both cockpits.

COCKPIT AIR CONDITIONING AND PRESSURIZATION SYSTEM.

The cockpit air conditioning system (figure 1-69), supplies air under pressure for heating, pressurizing and ventilating the cockpit. A single duct directs hot pressurized air, bled from the compressor section of the engine, to the following: cockpit air conditioning, windshield rain removal, side windshield defrosting, foot warmers and back warmer and cabin air inlet in the rear cockpit. Manual or automatic controls divert a portion of the hot air to a heat exchanger where it is partially cooled and

COCKPIT AIR CONDITIONING AND PRESSURIZATION SYSTEM

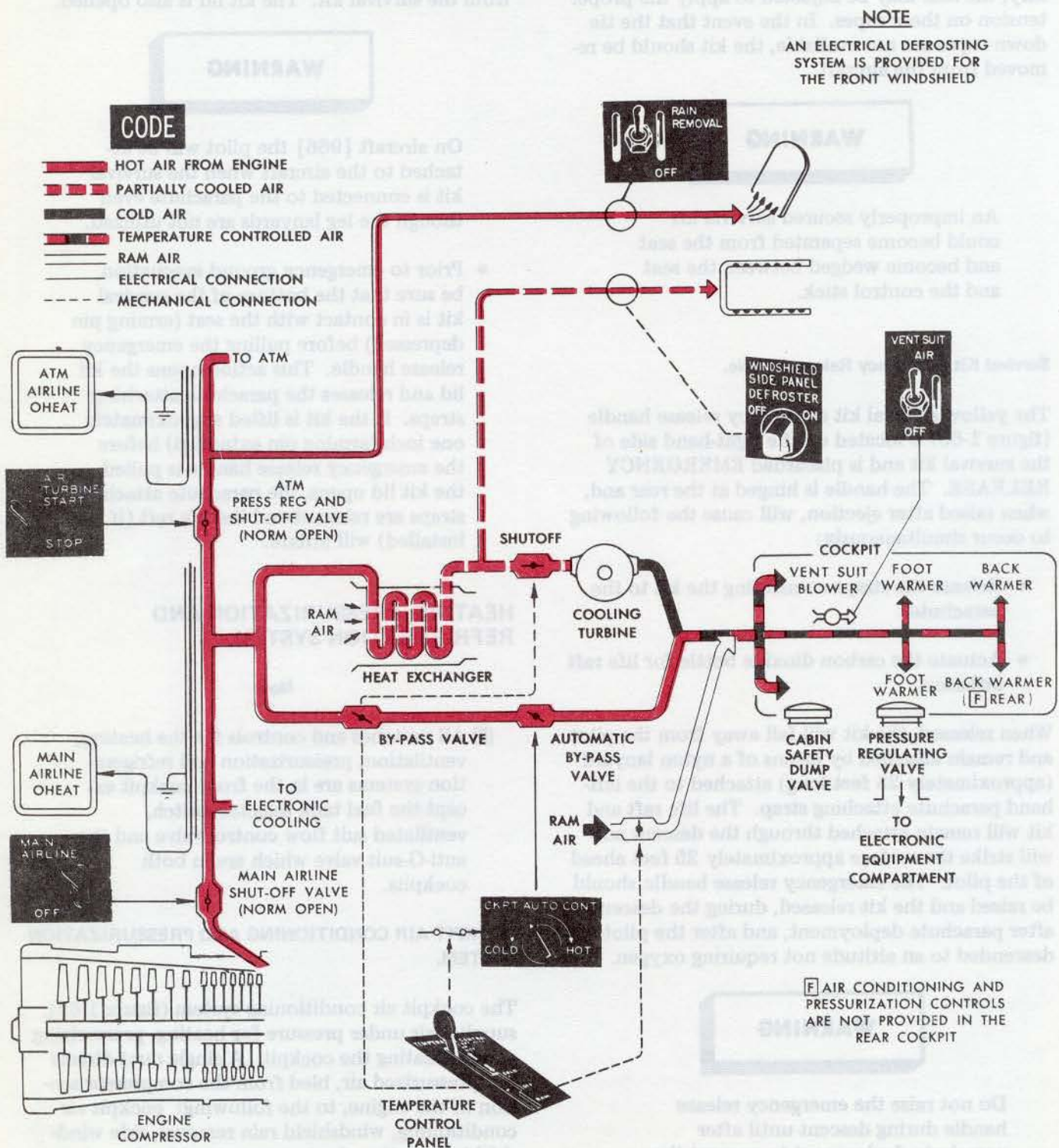


Figure 1-69

COCKPIT PRESSURE **schedule**

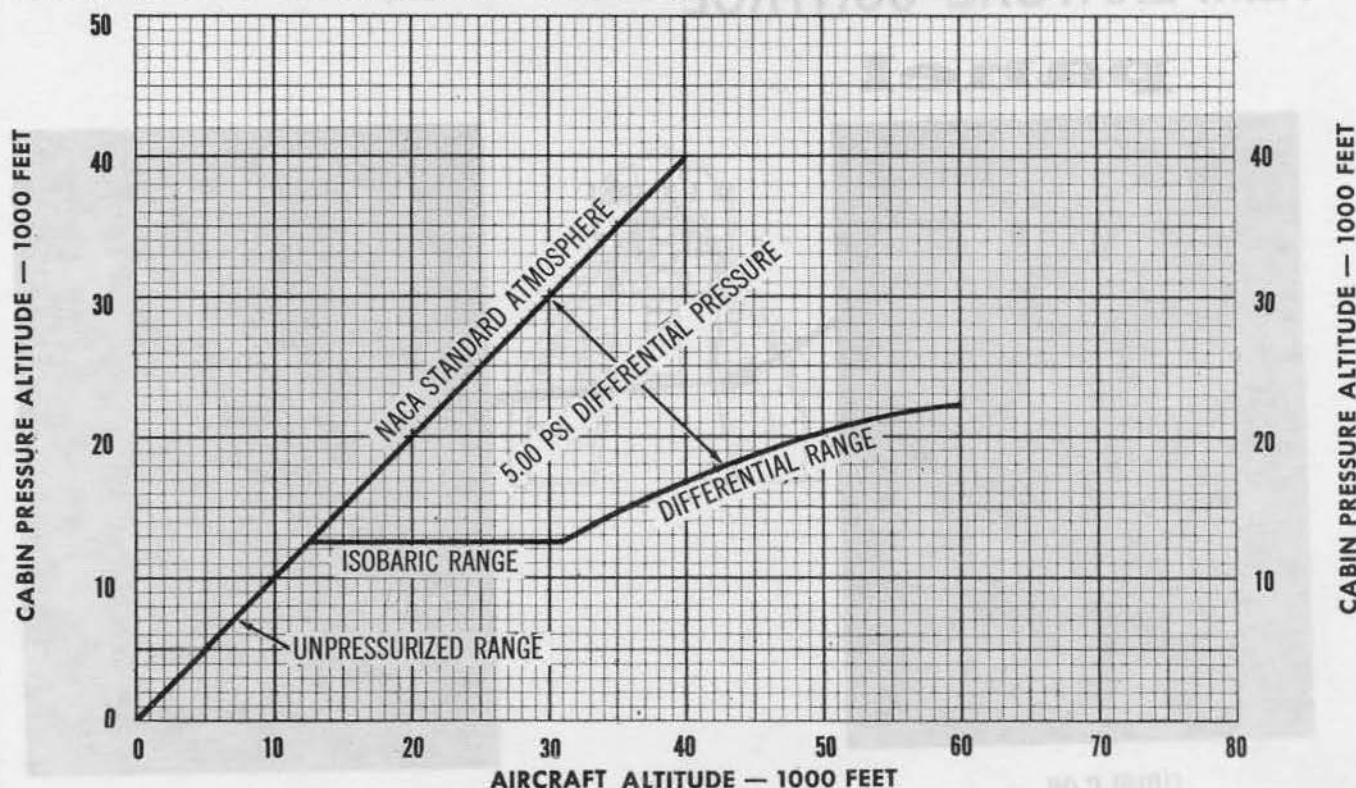


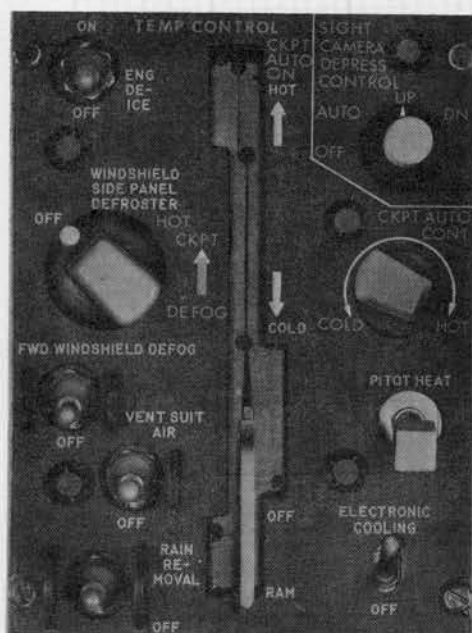
Figure 1-70

then directed to a turbine which cools it still further. This cooled air, which is combined with the hot air from the engine and controlled to vary the cockpit air temperature, enters each cockpit through two tubes (one at each side aft of the pilot's seat) and two foot warmers (hollow perforated tubes on which the rudder pedals ride). The pressure regulator automatically maintains the cockpit pressure schedule (figure 1-70) by controlling the outflow of air, and directing it to increase the cooling in the electronic compartments and turtle deck area as needed. An increase in cockpit pressure, restricted automatically to $\frac{3}{4}$ ($\pm \frac{1}{4}$) PSI a minute, may occur when the aircraft descends to a lower altitude. A cabin altitude marker on the altitude vertical velocity indicator (figure 1-51) shows the equivalent cockpit altitude. A safety valve in the air conditioning system incorporates automatic pressure and vacuum relief features which protects the cockpit from high or low pressures, and a dumping function which protects the cockpit from high or low pressures, and a dumping function which, when necessary, is used to relieve the cockpit pressure.

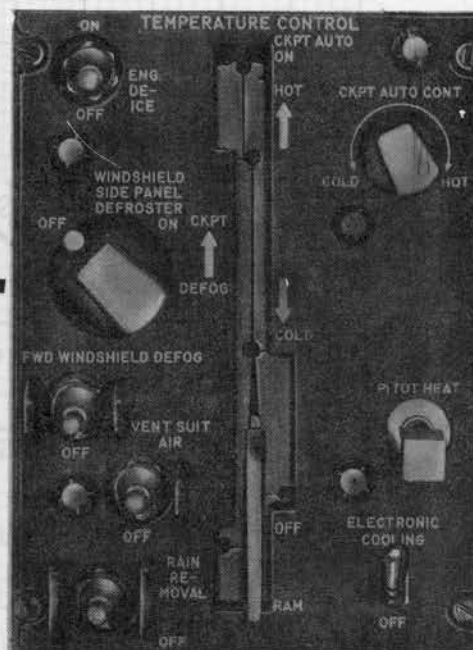
Temperature Control Lever.

The temperature control lever (figure 1-71) (not in rear cockpit) manually selects cockpit temperatures, ventilates the cockpits, and energizes the automatic temperature control system, and has six positions: HOT, CKPT DEFOG, COLD, OFF, and RAM, and an automatic position marked CKPT AUTO ON. When in the CKPT AUTO ON position (automatic operation), temperature in the cockpit is maintained at that selected on the cockpit temperature knob. In automatic or manual control the temperature will be maintained approximately between 40° and 90° F during average flight conditions. The automatic control will not hold stable temperature at idle or low RPM on the ground, above MACH 1.6 at high altitude or at high airspeed at low altitude. If the automatic system fails or malfunctions, cockpit temperature can be selected manually by moving the temperature control lever within the HOT-COLD range. If AC secondary power fails, temperature control is maintained by manual operation of the temperature control lever in the HOT-COLD range which positions a by-pass valve. When

TEMPERATURE CONTROL panel



[1018] C/W



[1018] N/C/W

Figure 1-71

in the COLD position, all hot air from the engine bleed line is routed through the cooling turbine. As the control lever is moved toward the HOT position, hot air is allowed to flow around the cooling turbine and mix with the turbine cooled air. At the same time, the amount of air directed to the cooling turbine is decreased. Moving the control lever towards HOT, increases the cockpit temperature proportionately until the control is in the HOT or CKPT DEFOG position, where the minimum flow of air is through the turbine and the turbine speed is reduced. With the temperature control in the OFF position all valves are closed and no air enters the cockpit. The RMA position mechanically actuates the dum valve to relieve cockpit pressure, and opens the ram air valve to allow outside air to circulate through the cockpit.

WARNING

Use 100% OXYGEN to offset effects of possible cockpit contamination when the temperature control lever is OFF.

CAUTION

At low altitude and high airspeed (especially at high, outside, air temperatures) the RAM air position can cause excessively high cockpit air temperatures, which can be reduced by decreasing airspeed and/or increasing altitude.

Note

The heating pressurization and refrigeration system will not operate when the main hot air line shutoff valve switch is OFF. Only ram air will be available for cockpit and modular cooling.

Cockpit Temperature Knob.

The cockpit temperature knob (figure 1-71) (not in rear cockpit) marked CKPT AUTO CONT, is powered by single phase, 115 volt, AC secondary power and has two positions — HOT and COLD. The knob may be rotated to any position between

HOT and COLD to manually select and maintain the desired temperature, only when the temperature control lever is in the CKPT AUTO ON position.

Normal Operation of Cockpit Air Conditioning and Pressurization System.

1. Canopy — CLOSE and lock.
2. Temperature control lever — CKPT AUTO ON.
3. Cockpit temperature knob — As desired.

Note

If condensation in the form of mist or snow is blown into the cockpit from the air conditioning outlets, a higher cockpit temperature can be selected or the temperature control lever can be placed in the RAM position.

Emergency Operation of Cockpit Air Conditioning and Pressurization System.

See section III.

ELECTRONIC COOLING AND PRESSURIZED AIR SYSTEM.

The electronic cooling and pressurized air system (figure 1-72) consists of two subsystems: (a) an air conditioning package similar to the cockpit air conditioner which operates on engine bleed air and maintains the equipment in the forward equipment compartments at a temperature required for reliable operation; (b) a modular cooling system which utilizes a blower and ram air at ambient temperature to cool the electronic modules for the CIN, Doppler, Fire Control, R-14 Radar, and Autopilot systems. The two subsystems are interconnected to permit the air conditioning package to cool the modules when air conditioning package to cool the modules when ram air temperature to the modules exceed 110°F. The aft electronic compartments and turtledeck areas are cooled by cockpit exhaust air.

Air Conditioning Package.

The air conditioning system operates only when the engine is running. A duct directs hot pressurized air to the air conditioning package. Air which has been partially cooled by the package heat exchanger is directed to the radar transmitter, canopy seal, the anti-G suit and the external fuel tanks. Temper-

ature in the forward equipment compartment is automatically maintained at approximately 85°F from sea level to 50,000 feet. A temperature probe in the forward equipment compartment controls a modulating valve located at the turbine inlet of the air conditioner, thereby regulating the amount of bleed air going to the air conditioner. If the compartments air temperature exceeds 150°F a light on the caution light panel will illuminate. Power for the air conditioning system is supplied by single phase 115 volt AC secondary power and the DC primary power.

Modular Cooling System.

When the aircraft is on the ground and external power is supplied or the engine is running, a blower operates to circulate ambient air through the electronic modules. A time delay interlock prevents the operation of the CIN power supply on the ground if the blower is inoperative. On takeoff, as the weight is taken off the main landing gear, a switch automatically causes the ram air shutoff valves to open thereby forcing air through the modules. The blower is shut off by a switch when the nose gear retracts. The blower is powered by three phase AC secondary power and the CIN power supply is powered by 28 volt DC primary power and three phase 200 volt AC secondary power. If AC secondary power fails during flight with the landing gear extended the blower will be inoperative but the modular cooling system including CIN power supply will be cooled by the electronic cooling and pressurized air system.

Electronic Cooling Switch.

The electronic cooling switch (figure 1-71) (not in rear cockpit) is marked ELECTRONIC COOLING, and has two positions: OFF and unmarked ON. In the ON position, temperature in the auxiliary electronic and forward electrical compartments is automatically maintained within limits by the air conditioning control system. If high temperature ram air conditions are encountered package cooling air is supplied to cool the CIN, Doppler and fire control systems. In the OFF position (used only when an overheat condition exists or for ground test), DC primary power energizes and closes the air modulating valve, preventing air from entering the compartments from the refrigeration unit. Only ram air is available for cooling the CIN, Doppler and fire control systems.

Note

On aircraft [948] C/W, if an overheat condition exists (illumination of the

ELECTRONIC COOLING and pressurized air system

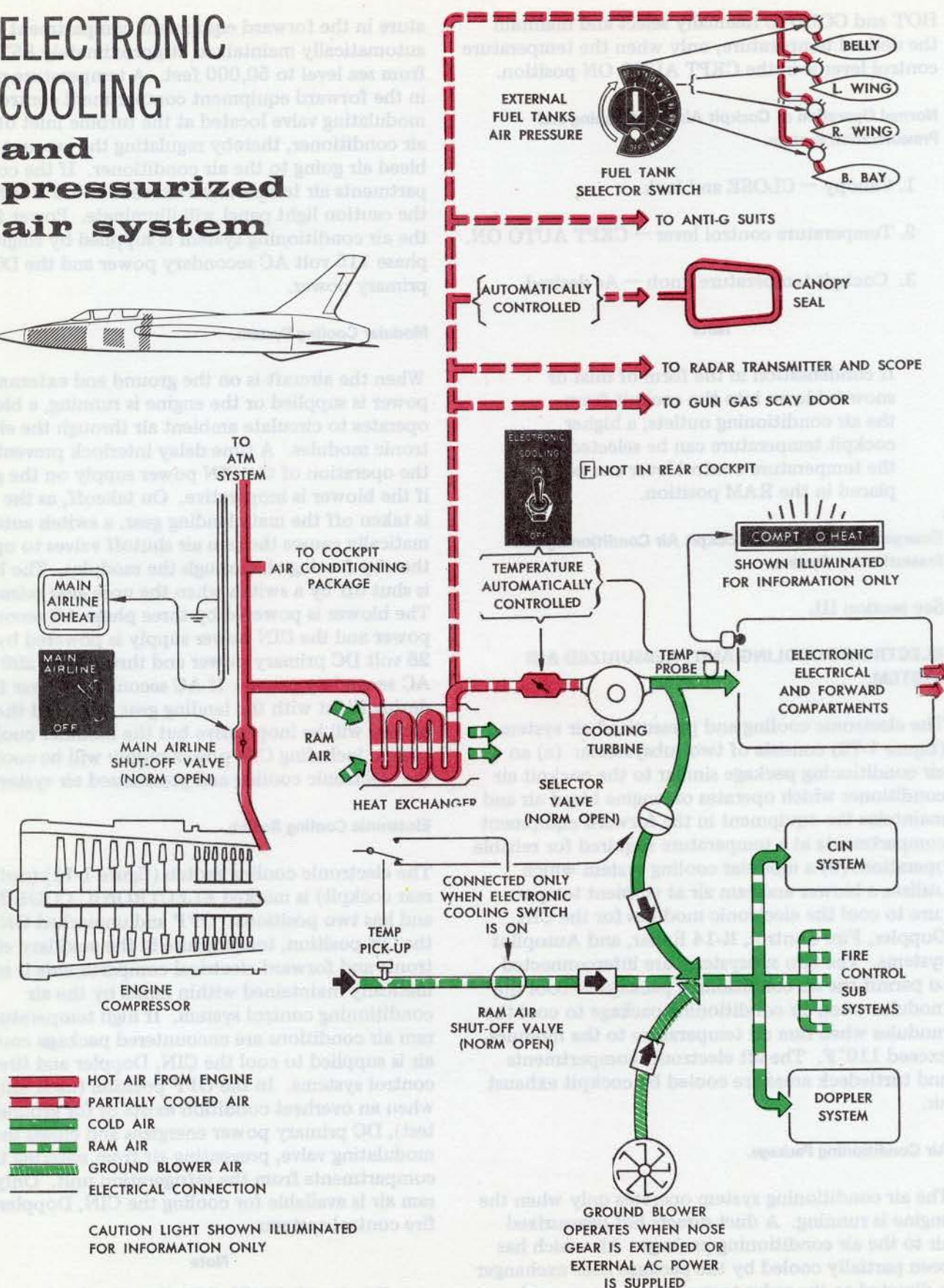
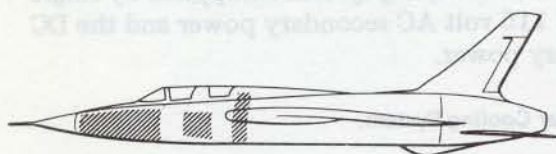


Figure 1-72

Note (Continued)

main hot air line caution light) place the electronic cooling switch OFF. This will remove power from the ram air valve and lock it in the full open position.

Compartment Overheat Light.

The compartment overheat light (figure 1-60) on the caution light panel displays COMPT O'HEAT and is powered by DC primary power. Illumination of the light indicates temperature in the compartments has increased to approximately 150°F. If the light remains on (indicating cooling turbine failure), the electronic cooling switch should be placed in the OFF position to stop the flow of air to the cooling turbine.

NORMAL OPERATION.

1. Place the electronic cooling switch to ON. The electronic cooling and pressurized air system will automatically maintain temperature within limits.

EMERGENCY OPERATION.**Air Conditioning Package.**

See compartment overheat light illumination procedure in section III.

Modular Cooling System.

Failure of the blower to operate properly while on the ground may result in overheating of the CIN power supply. If the CIN power supply overheats the CIN PWR caution light will cycle on and off. During an overheat condition the CIN power supply is in emergency backup operation (refer to CIN MAIN POWER SUPPLY CAUTION LIGHT in this section). The radar, fire-control, autopilot and Doppler should be turned off immediately to reduce heat in the compartments. The CIN equipment will resume normal operation (with ram air cooling) when the weight is off the wheels, since the ram air valve opens when the nose gear is up and locked. No restrictions are subsequently imposed on any of the aforementioned equipment during flight; however, this equipment should be turned off prior to lowering gear for a landing, if practicable, or as soon as possible after landing. If operation of the blower is normal, but the nose gear fails to retract on takeoff, aircraft operation should be limited to a maximum of 15,000 feet altitude. Above 15,000 feet the blower will not cool sufficiently to prevent overheating of the modules.

Aircraft have a main hot air line shutoff valve switch incorporated to shutoff air between the engine and the air conditioning packages. If this switch is positioned to OFF, because of a hot air leak, the air conditioning packages will be inoperative together with the AC generator. If the landing gear is extended with these conditions the ARC-70 radio can be expected to cycle off approximately one and one-half minutes after the gear is extended. After the first off cycle, the ARC-70 radio will normally continue to cycle on and off at approximately one and one-half minute intervals.

DEFROSTING, DEFOGGING, AND RAIN REMOVAL SYSTEMS.**Note**

- [F] All switches for these systems are in the front cockpit.
- The defrosting, defogging and rain removal systems will not operate when the main hot air line shutoff valve switch is OFF.

WINDSHIELD DEFOGGING SYSTEM.

The center glass panel in the windshield contains an electrical conductive transparent sheet which, when heated, defogs and defrosts the glass. A thermostat in contact with the inner surface of the panel, in conjunction with a single phase, 115 volt, AC secondary power, controls and maintains the panel at the correct temperature. When power is applied it heats the panel to about 110°F (43°C), at which point the thermostat will shut off the power. When the temperature decreases sufficiently, the thermostat will turn on power to heat the panel again, thus keeping its temperature within the setting of the thermostat.

CAUTION

The heating element should be turned off during ground operation to prevent damage to the glass panel because of overheating. Lack of airflow over the panel may cause uneven heat distribution and eventual damage.

Windshield Defogging Switch.

The guarded windshield defogging switch (figure 1-71) (not in rear cockpit) placarded FWD WINDSHIELD DEFOG, has two positions: unmarked ON and placarded OFF. It controls single phase, 115 volt, AC secondary power to the windshield defogging system.

Operation of Windshield Defogging System.

The windshield defogging system should be turned off for all ground operation. For takeoff and during flight the windshield defogging switch is moved to the ON position in areas of high humidity or when visible moisture is present.

WINDSHIELD SIDE PANEL DEFROSTING SYSTEM.

Perforated tubes, clamped to brackets on the front windshield panels, are connected by tubing and flexible hoses to a manually operated hot air shutoff valve that is supplied with air which has passed through part of the heat exchanger. The amount of air directed to the perforated tubes is manually controlled.

Windshield Side Panel Defroster Knob.

The amount of air being supplied to the windshield side panel defroster tubes is manually controlled by the windshield side panel defroster knob (figure 1-71) (not in rear cockpit) placarded WINDSHIELD SIDE PANEL DEFROSTER. The control rotates 90 degrees between the HOT and OFF positions with four intermediate detents to regulate the flow of air.

Note

The knob will rotate freely at idle RPM, but at higher thrust settings may require more force to turn.

Operation of Windshield Side Panel Defrosting System.

The windshield side panel defrosting system should be operated as required. Cockpit temperature should be maintained as high as possible consistent with pilot comfort to remove or prevent frost formation upon descent.

ANTIFOGGING SYSTEM.

The antifogging system provides dry air between the double glass panels of the side windshield and

the canopy windows to prevent moisture deposit on the inside surfaces. The area between the glass panels is vented through the desiccator in the cockpit in the vicinity of the air conditioning outlets behind the pilot's seat. The air-drying system is never inoperative because any air that enters the space between the double glass panels will always pass through the desiccator.

WINDSHIELD RAIN REMOVAL SYSTEM.

The windshield rain removal system provides a high velocity stream of hot air from the engine compressor stage to clear rain, ice, or snow from the center windshield panel at traffic pattern speeds or below. The air passes through a duct to a discharge nozzle located forward of, and below, the center windshield panel. A manually operated switch enables the pilot to control the solenoid-operated shutoff valve in the rain removal hot air duct. Temperatures in the hot air duct can vary from 200° to 900°F (93° to 482°C). The system is powered by DC secondary power.

Rain Removal Switch.

The rain removal switch (figure 1-71) (not in rear cockpit) is a two-position toggle switch placarded RAIN REMOVAL with an OFF and an unmarked ON position. In the OFF position, the solenoid shutoff valve is deenergized and remains closed. In ON position the solenoid valve is energized by DC secondary power and will open provided the air supply is adequate for both the ATM and rain removal. This feature prevents starving the ATM if the air supply is insufficient. The valve will open and the system operate at sea level at 60 degrees F at a minimum of 74 percent RPM.

Note

On aircraft modified by T.O. 1F-105-1078, the windshield rain removal system operation is limited through a switch on the landing gear handle (figure 1-5). The rain removal system will operate only when the landing gear handle is in the DOWN position and the rain removal switch is ON. When the gear handle is moved to the UP position, the rain removal switch will physically cycle to OFF. When needed again, the landing gear handle must be placed in the DOWN position and the rain removal switch moved to ON. The switch is spring-loaded to OFF when the landing gear handle is in the UP position.

- On aircraft not modified by T.O. 1F-105-1078 the airspeed should not be allowed to go above 270 KCAS with the rain removal switch on.
- Each 1000 foot increase in altitude will require an increase of 1.25 percent to the minimum RPM.

- Each 10 degree F increase in temperature will require an increase of 0.75 percent to the minimum RPM.
- Each 10 degree F decrease in temperature will permit a decrease of 0.75 percent to the minimum RPM.

In the event of DC secondary power failure or mechanical failure, the valve will close and stop the flow of hot air in the rain removal duct.

Operation of Windshield Rain Removal System.

1. Place the rain removal switch in the ON position for takeoff and landing, if necessary.

CAUTION

The windshield rain removal system should only be operated below 270 KCAS during takeoff and landing, if required. If the system is allowed to remain ON during other periods, excessive heat will crack the windshield.

ANTI-ICING AND DEICING SYSTEMS.**Note**

- ☐ All switches for these systems are in the front cockpit.

PITOT HEATER.

The pitot tube (34, figure 1-1) is electrically heated to prevent ice formation. The heater is powered by DC primary power.

Pitot Heat Switch.

The pitot heat switch (figure 1-71) (not in rear cockpit) is a two-position toggle switch placarded PITOT HEAT with an unmarked ON and a placarded OFF position. The ON position energizes the heating element in the pitot tube and keeps it free of ice. The ON position also energizes a heating element in the angle of attack sensor vane to keep it free of ice.

CAUTION

The pitot heater should not be used on the ground as serious overheating will occur because of insufficient airflow.

ENGINE ANTI-ICING SYSTEM.

The engine anti-icing system placarded ENG DE-ICE is provided to prevent the accumulation of ice on the engine inlet guide vanes. Hot air from the engine compressor 15th stage is ducted to the engine inlet guide vanes when an electrically operated anti-icing valve is open. A toggle switch controls the circuit which opens and closes the valve. A caution light illuminates when the valve is fully open. The system receives its power from the DC primary bus.

Engine Anti-Icing Switch.

The engine anti-icing switch (figure 1-71) (not in rear cockpit) located on the temperature control panel is a two-position switch placarded ENG DE-ICE with positions ON and OFF. The ON position energizes an electric actuator which opens the anti-icing valve to permit hot air from the engine compressor 15th stage to flow to the engine inlet guide vanes. The OFF position energizes the electric actuator to close the valve and shut off the flow of hot air to the engine inlet guide vanes. In the event of DC primary power failure, the valve will become inoperative and remain in its last position.

Engine Ice Caution Light.

The engine ice caution light on the caution light panel (figure 1-60) displays ENG ICE and is powered by the DC primary power. Illumination of the light only indicates the anti-icing valve is fully open.

Operation of Engine Anti-Icing System.

When flying through areas of known or suspected areas of icing, the engine anti-icing switch should be placed in the ON position. Engine anti-icing is most effective at high-thrust and low airspeeds.

Note

Avoid prolonged use of the engine anti-icing system when icing conditions do not exist as range will be decreased by one to two percent.

LIGHTING EQUIPMENT.**EXTERIOR LIGHTS.****Note**

- ☐ All exterior light switches and controls are located in the front cockpit.

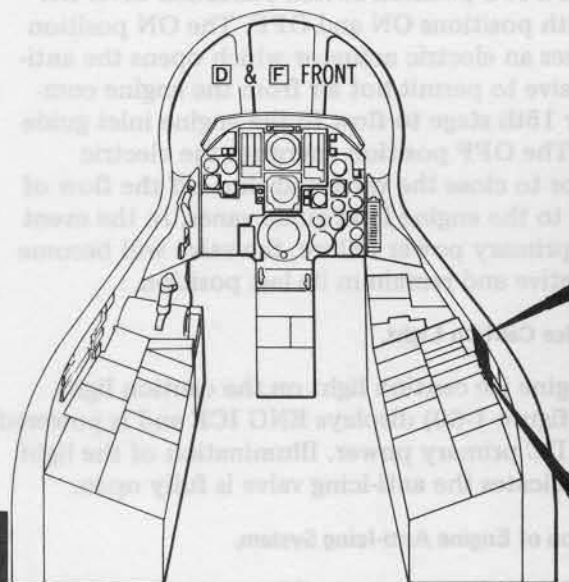
Landing Lights.

Two landing lights are mounted on the lower part of the nose gear strut. The landing lights are powered by the DC secondary power, and the circuit is completed through the left landing gear aft inboard door uplock switch so that the lights will be out when the gear is retracted regardless of the position of the landing and taxi lights switch.

Taxi Light.

A taxi light is mounted on each main landing gear strut directly above the torque arms and one mounted on the lower part of the nose gear strut on unmodified aircraft. The taxi light is powered by

EXTERIOR LIGHTS control panel



INTERIOR LIGHTS control panel

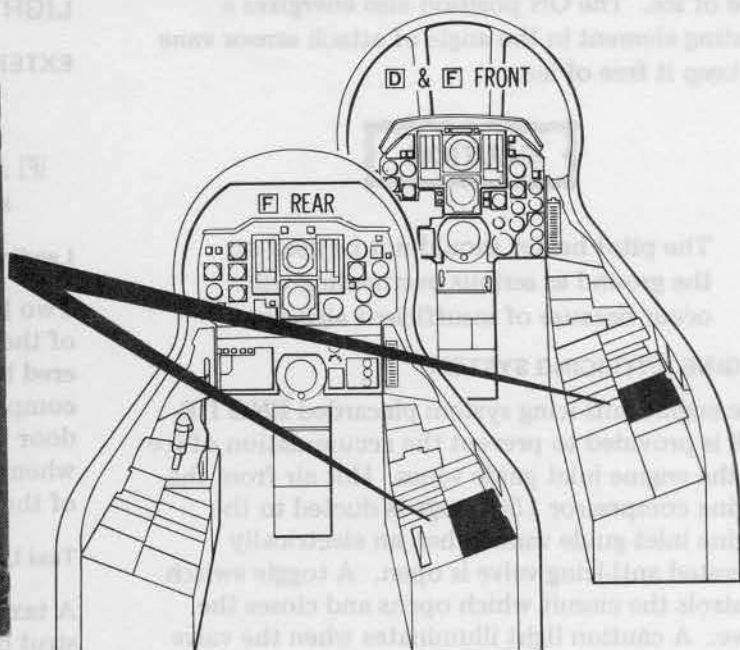
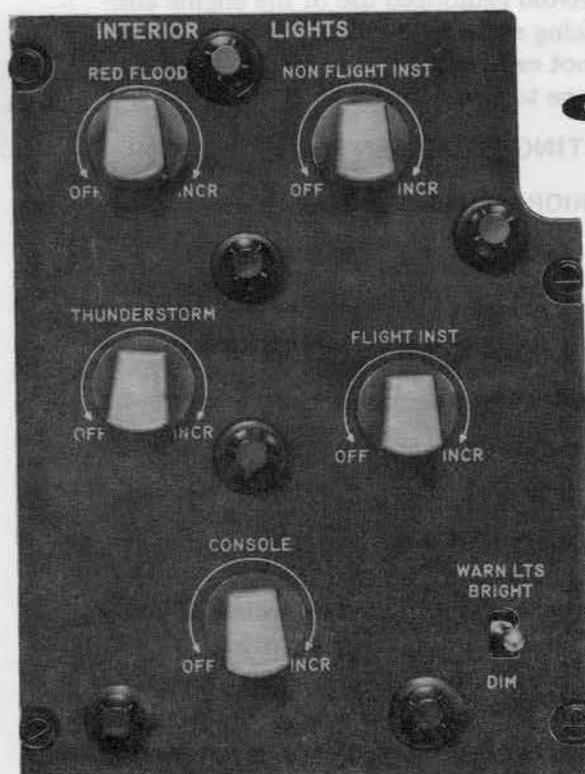


Figure 1-73

the DC secondary power and the circuit is completed through the nose gear uplock switch so that the light will be out when the gear is retracted regardless of the position of the landing and taxi lights switch.

CAUTION

Due to the limited illumination by the taxi light, the landing lights should be used instead of the taxi light when taxiing in poorly lighted areas.

Landing and Taxi Lights Switch.

The landing and taxi lights switch (figure 1-5) (not in rear cockpit) is a three-position switch marked LDG LIGHT ON, OFF, and TAXI LIGHT ON. When placed in the LDG LIGHT ON or the TAXI LIGHT ON position, DC secondary bus power will be supplied to illuminate the respective light provided the landing gear is not in the up-and-locked position.

Formation Lights.

Formation lights, consisting of luna white lights, one each in the rudder fairing and one each mounted on aft fuselage, on each side of the vertical stabilizer, are powered by DC secondary power and controlled by a switch (figure 1-73) (not in rear cockpit) marked FORMATION LT. The switch has three positions: BRIGHT, OFF and DIM

Position Lights.

The position lights consist of red (left) and green (right) lights in the wing tips and two white lights in the vertical fin tip, and white lights on the top, bottom and sides of the forward fuselage. The top fuselage light is enclosed within a transparent section of the turtledeck. The lights require DC secondary power.

Position Light Switch.

The position light switch (figure 1-73) (not in rear cockpit) has three positions: FLASH, OFF, and STEADY. When in the STEADY position, the wing and tail lights will be illuminated. When the switch is moved to FLASH position, the red, green, and white tail lights flash alternately at the rate of 40 cycles per minute.

Position Lights Dimmer Knob-Wing Tips & Tail.

Brilliance of the wing tip and tail lights is controlled by a position lights dimmer knob (figure 1-73) (not in rear cockpit) placarded L & R WING TIPS &

TAIL, whose positions are DIM, $\frac{1}{2}$ BRIGHT, and BRIGHT. When the position lights switch is in the STEADY or FLASH positions, movement of the knob clockwise from the DIM position to the $\frac{1}{2}$ BRIGHT or BRIGHT position increases the brilliance of the lights.

Fuselage Position Lights Knob.

The fuselage position lights knob (figure 1-73) (not in rear cockpit) is placarded TOP & BOTTOM FUSELAGE with positions of OFF, DIM, $\frac{1}{2}$ BRIGHT, and BRIGHT. When the knob is moved clockwise from the OFF position to the DIM, $\frac{1}{2}$ BRIGHT or BRIGHT position the fuselage position lights increase in brilliance.

Anti-Collision Lights

[1080] C/W

Two anti-collision lights are mounted externally, one on top and one on the bottom of the fuselage. The top light is in the turtle deck area. The bottom light on [D] aircraft is located forward of the nose wheel well and on [F] aircraft aft of the nose wheel well. Each light consists of a lamp and reflector mounted on a motor driven turntable enclosed in a red cover. The lights rotate at a speed of 80 revolutions per minute which simulates 80 flashes per minute. The lights are powered by DC primary power.

Anti-Collision Lights Switch

[1080] C/W

The anti-collision lights switch (figure 1-73) is a rotary switch placarded ANTI-COLLISION LTS with positions marked OFF, BOTH, TOP and BOTTOM. These positions allow the lights to be illuminated individually or both simultaneously. A circuit breaker is provided for the circuit adjacent to the switch.

INTERIOR LIGHTS.

The interior lighting consists of red flood lights arranged to cast light on the switch panels and instruments, edge lights for various panels, individual instrument lights, thunderstorm lights, a cockpit utility light, and a navigation light (goose-neck). Ten, red floodlights, including one on the left side of the canopy and one on each side of the windshield and windscreen frames, mounted on the sides of the cockpit, illuminate the main instrument panel and consoles. Instrument lights are mounted on the instruments to illuminate individual dial faces. Edge lights, which are powered similar to the instrument lights, illuminate the plastic panel engraved lettering. The lights produce a filtered red light diffused throughout the plastic material to provide illumination of the engraved surface markings. Each light fixture contains a bulb shielded from view by a knurled cap. The

interior lights are controlled by five knobs (figure 1-73), placarded RED FLOOD, THUNDERSTORM, CONSOLE, NONFLIGHT INST and FLIGHT INST. The knobs are placarded with an arrow indicating intensity control range and OFF and INCR at the extremities of the arrow. The FLIGHT INST knob controls the integrated and standby instrument lights, the clock lights, depressed reticle control lights, and also controls the advisory lights which are, the HSI mode lights, R-14 radar system range lights, clearance plane indicator lights, radar mode indicator

lights, the sight head range lights and the control transfer button lights in the [F] when any of these systems are in operation. However, the OFF position delivers a fixed voltage which permits illumination of these lights at full-bright. When the knob is moved from OFF in a clockwise direction, all the above lights are dimmed (minimum brightness). When the knob is moved toward the INCR position, the lights increase in brightness until at full INCR the lights are full-bright. The flight instrument lights are

OXYGEN SYSTEM

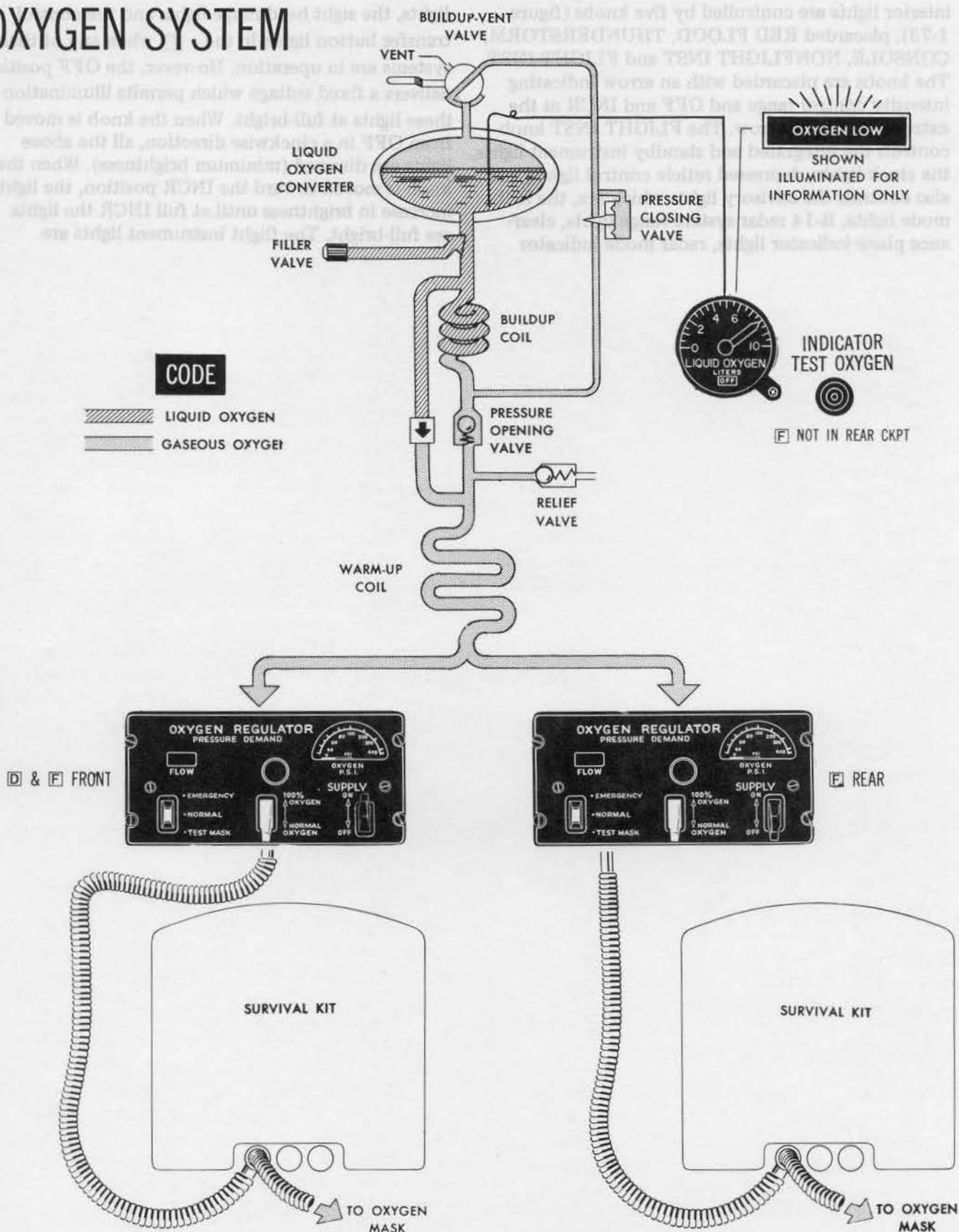


Figure 1-74

powered by AC primary power while the nonflight instrument lights are powered by the AC secondary power. The console, red flood, and thunderstorm lights are powered by DC secondary power.

Cockpit Utility Light.

The cockpit utility light (19, figure 1-7) located on the right console is powered by DC primary power. The light is controlled by a rheostat which is an integral part of the light; however, a pushbutton switch on the light provides full brilliance of the light regardless of the rheostat setting. The forward section of the light rotates to four detented positions, providing flood red, spot red, spot white and flood white light.

Navigation Light (goose-neck).

The navigation light, stowed on the windshield bow (and above the rear instrument panel) are powered by DC primary power. The light can be positioned, as desired, by the flexible shaft and controlled by a rheostat located at the lower end of the shaft above the right auxiliary panel. A red or white light can be obtained by rotating the light cover.

OXYGEN SYSTEM.

The oxygen system (figure 1-74) is of the liquid oxygen type. The major components of the system are a converter, a quantity gage, an external filler valve, and a regulator on the right console. The converter consists of a 10 liter, insulated, storage container and a converter, which changes the liquid oxygen to gaseous oxygen and then supplies pressure to the oxygen regulator. The regulator in turn supplies the crew member with breathing oxygen. In the [F] each crew member controls his own oxygen supply. Oxygen duration at various altitudes is shown in figure 1-76. The liquid oxygen system is serviced through a single point filler valve located within an access door on the forward left side of the fuselage (figure 1-78).

OXYGEN REGULATOR.

A combination pressure breathing diluter demand MD-1 oxygen regulator (figure 1-75) is mounted on the right console for use in conjunction with a MS22-001 standard military type mask or equivalent. The oxygen system is controlled by the supply, the diluter, and the emergency levers. Gaseous oxygen is supplied to each regulator and the pressure gage will indicate 60 to 145 PSI. The regulator reduces the oxygen pressure, mixes oxygen with air in varying amounts depending on altitude and

pilot demand, and delivers it through flexible tubes to the pilot's mask. At high altitude, the regulator supplies positive pressure breathing. It will be noted in the oxygen duration chart that an increasing number of man-hours of oxygen is available above 25,000 feet altitude when operating with the diluter lever in the NORMAL OXYGEN position. With increasing altitude, the volume of an equivalent mass of air at sea level increases. The regulator attempts to maintain a constant flow of oxygen to the lungs by increasing the oxygen flow from the oxygen system, and decreasing the amount of air mixed with the oxygen. Beyond the altitude at which 100 percent oxygen is being used, further expansion of the gas will occur and, unless a pressurized system is used, the lungs cannot expand sufficiently to absorb the normal oxygen consumption. Therefore, even with a pressurized system though not as soon, an altitude will be reached beyond which less and less mass will be absorbed because of the continually expanding gas. The pilot receives a visual indication of system operation from the flow indicator and oxygen pressure gage located on the oxygen regulator panel.

Diluter Lever.

The diluter lever (figure 1-75) has two positions: NORMAL OXYGEN and 100% OXYGEN. With the lever at NORMAL OXYGEN, the regulator mixes air with oxygen in varying amounts, according to altitude, and delivers it through a flexible tube to the pilot's mask. With the lever at 100% OXYGEN the regulator delivers 100 percent oxygen regardless of altitude.

Emergency Lever.

The emergency lever (figure 1-75) has three placarded positions: EMERGENCY, NORMAL and TEST MASK. The lever should remain in the NORMAL position at all times, unless an unscheduled pressure increase is required. Moving the lever to EMERGENCY with the diluter lever in 100% OXYGEN provides continuous positive pressure of 100 percent oxygen to the mask. If the EMERGENCY position is selected with the diluter lever in NORMAL OXYGEN, dilution of the oxygen with cockpit air will occur depending on cockpit altitude. When the lever is held in the TEST MASK position, it provides positive pressure to test the mask for leaks.

WARNING

When placing the emergency lever in EMERGENCY or TEST MASK, it is



OXYGEN REGULATORS

control panel

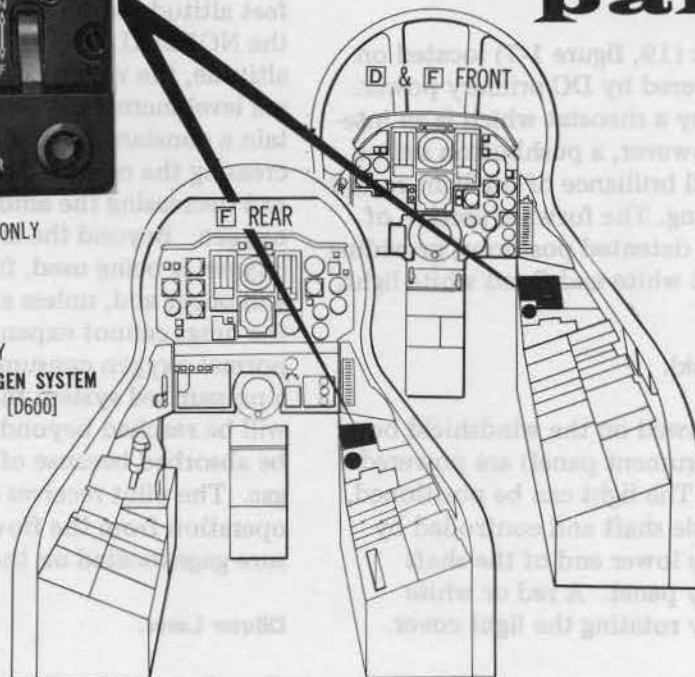


Figure 1-75

Warning (Continued)

mandatory that the oxygen mask must be fitted to the face and not removed. Continuous use of positive pressure with a leaking oxygen mask or the mask removed for extended time periods will not only deplete the oxygen supply rapidly, but will also result in extremely cold oxygen and possible flow of liquid oxygen to the regulator.

Oxygen System Supply Lever.

The oxygen system supply lever (figure 1-75) is placarded SUPPLY with positions ON and OFF is located on the right aft end of the regulator. When the lever is in the ON position, oxygen is permitted to flow into the regulator, and when in the OFF position, flow is prevented.

WARNING

- D** The pressure oxygen system control lever for the high altitude oxygen system, located on the forward right console (figure 1-75), must be in the OFF

position to prevent loss of oxygen through the survival kit oxygen regulator.

Pressure Gauge and Flow Indicator.

A pressure gauge and a flow indicator (figure 1-75) are located on the oxygen regulator panel. The pressure gauge shows gaseous oxygen pressure in PSI in the supply line whether or not the system is in use. The flow indicator consists of an oblong opening on the face of the regulator panel, is placarded FLOW, and shows white and black, alternately, during the breathing cycle.

OXYGEN QUANTITY GAGE.

An oxygen quantity gage (figure 1-75) located on the right console aft of the regulator panel, indicates the quantity of oxygen in the converter and is calibrated in liters from 0 to 10. The gage is of the capacitance type and accurately records the liquid oxygen supply in the converter. Power is supplied from the single phase, 115 volt, AC primary power. If AC primary power fails, a red flag marked OFF will appear in a small opening in the face of the gage.

Note

- Ⓕ The front gage is the master gage and directly records the amount of oxygen in the converter. The rear gage records the front gage reading (± 0.3 liters). If the front gage is inoperative or erratic the rear gage will be unreliable. If the front gage is reading stable and the rear gage is inoperative the front gage readings will be considered valid and the aft gage will be disregarded.

Oxygen Warning Test Button.

An oxygen warning press-to-test button (figure 1-75) (not in rear cockpit) placarded TEST OXYGEN INDICATOR located to the right of the oxygen quantity gage, checks the operation of the oxygen low caution light circuit. When the button is depressed and held, the indicator circuit moves the needle on both quantity gages to beyond zero. When the needle reaches one liter or less, the caution light in each cockpit will illuminate. Releasing the button will activate the indicator circuit, the gage will read the true oxygen quantity and the lights will go out. The circuit is powered by DC primary power.

Oxygen Low Caution Light.

The oxygen low caution light (figure 1-60) located on the caution light panel, displays OXYGEN LOW and is powered by DC primary power. The lights will illuminate together with the master caution light when the liquid oxygen level in the converter is one liter or less.

Oxygen System Preflight Check.

Before take-off, the oxygen system should be checked as follows:

Note

This test procedure is applicable only for an initial preflight check of the system. Inflight or repeated tests made within short periods may produce false or misleading indications.

- Ⓕ • Each crew member must perform this check to assure proper operation in his cockpit.

1. Oxygen pressure gage — Check 60 to 145 PSI.

2. Oxygen quantity gage — Check as required. The oxygen system need not be full for local training missions. In the Ⓕ when flying dual the rear gage should read within ± 0.3 liter of the front gage.
3. Oxygen system supply lever — ON.
4. Emergency lever — NORMAL.
5. Check oxygen regulator with the diluter lever first at NORMAL OXYGEN and then at 100% OXYGEN as follows: Blow gently into the end of the regulator hose as during normal exhalation. There should be resistance to blowing. Little or no resistance to blowing indicates a leak or faulty operation.
6. Oxygen hose — Connect. Connect oxygen hose as shown in figure 1-77.
7. With the oxygen mask connected to the regulator and the diluter lever at 100% OXYGEN, breathe normally into the mask and conduct the following checks:
 - a. Observe flow indicator for proper operation.
 - b. Place emergency lever to EMERGENCY. A positive pressure should be supplied to the mask. Return emergency lever to NORMAL position.
 - c. Hold emergency lever in TEST MASK position. A positive pressure should result within the mask. Hold breath to determine whether there is leakage around mask. Release emergency lever: positive pressure should cease.
8. Retain diluter lever in 100% OXYGEN position or return diluter lever to NORMAL OXYGEN as required.

Normal Operation of Oxygen System.

- Ⓕ 1. Pressure Oxygen system lever — OFF.
2. Oxygen system supply lever — ON.
 3. Diluter lever — 100% OXYGEN or NORMAL OXYGEN (as required).
 4. Emergency lever — NORMAL.

OXYGEN DURATION HOURS

USING TYPE MD-1
DILUTER-DEMAND REGULATOR

Upper Figures Indicate Diluter Lever 100% Oxygen
Lower Figures indicate Diluter Lever Normal Oxygen

ONE CREW MEMBER											
CABIN ALTITUDE FEET	GAGE QUANTITY — LITERS										BELOW 1
	10	9	8	7	6	5	4	3	2	1	
35,000 and above	48.6	43.7	38.9	34.0	29.1	24.3	19.4	14.6	9.7	4.9	DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	48.6	43.7	38.9	34.0	29.1	24.3	19.4	14.6	9.7	4.9	
30,000	35.5	32.0	28.4	24.9	21.3	17.8	14.2	10.7	7.1	3.6	
	36.1	32.5	28.8	25.2	21.6	18.0	14.4	10.8	7.2	3.6	
25,000	27.4	24.7	21.9	19.2	16.4	13.7	10.9	8.2	5.5	2.7	
	34.0	30.6	27.2	23.8	20.4	17.0	13.6	10.2	6.8	3.4	
20,000	20.7	18.7	16.6	14.5	12.4	10.3	8.3	6.2	4.1	2.0	
	38.4	34.5	30.7	26.9	23.0	19.2	15.4	11.5	7.7	3.8	
15,000	16.6	15.0	13.3	11.7	10.0	8.3	6.7	5.0	3.3	1.7	
	46.7	42.0	37.3	32.7	28.0	23.3	18.7	14.0	9.3	4.7	
10,000	13.4	12.0	10.7	9.4	8.0	6.7	5.3	4.0	2.7	1.3	
	46.7	42.0	37.3	32.7	28.0	23.3	18.7	14.0	9.3	4.7	
5,000	10.6	9.5	8.5	7.4	6.3	5.3	4.2	3.2	2.1	1.1	
	46.7	42.0	37.3	32.7	28.0	23.3	18.7	14.0	9.3	4.7	
S. L.	8.6	7.7	6.8	6.0	5.1	4.3	3.4	2.6	1.7	0.9	
	46.7	42.0	37.3	32.7	28.0	23.3	18.7	14.0	9.3	4.7	

TWO CREW MEMBERS											
CABIN ALTITUDE FEET	GAGE QUANTITY — LITERS										BELOW 1
	10	9	8	7	6	5	4	3	2	1	
35,000 and above	24.3	21.9	19.4	17.0	14.6	12.1	9.7	7.3	4.9	2.4	DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	24.3	21.9	19.4	17.0	14.6	12.1	9.7	7.3	4.9	2.4	
30,000	17.8	16.1	14.2	12.4	10.7	8.9	7.1	5.3	3.5	1.8	
	18.0	16.2	14.4	12.6	10.8	9.0	7.2	5.4	3.6	1.8	
25,000	13.7	12.3	10.9	9.6	8.2	6.8	5.5	4.1	2.7	1.3	
	17.0	15.3	13.6	11.9	10.2	8.5	6.8	5.1	3.4	1.7	
20,000	10.3	9.3	8.3	7.2	6.2	5.2	4.1	3.1	2.1	1.0	
	19.2	17.3	15.4	13.4	11.5	9.6	7.7	5.8	3.8	1.9	
15,000	8.3	7.5	6.7	5.8	4.7	4.2	3.3	2.5	1.7	0.8	
	23.3	21.0	18.7	16.3	14.0	11.7	9.3	7.0	4.7	2.3	
10,000	6.7	6.0	5.3	4.7	4.0	3.3	2.7	2.0	1.3	0.7	
	23.3	21.0	18.7	16.3	14.0	11.7	9.3	7.0	4.7	2.3	
5,000	5.3	4.8	4.2	3.7	3.2	2.6	2.1	1.6	1.1	0.5	
	23.3	21.0	18.7	16.3	14.0	11.7	9.3	7.0	4.7	2.3	
S. L.	4.3	3.8	3.4	3.0	2.6	2.1	1.7	1.3	0.9	0.4	
	23.3	21.0	18.7	16.3	14.0	11.7	9.3	7.0	4.7	2.3	

Figure 1-76

OXYGEN MASK CONNECTIONS

CRU-60/P

PROPER ATTACHMENT OF THE OXYGEN HOSE CONNECTION is extremely important to assure that the oxygen hose does not —

- become accidentally disconnected during flight causing a loss of oxygen supply.
- prevent quick separation from the seat during ejection.
- flail during ejection causing pilot injury.

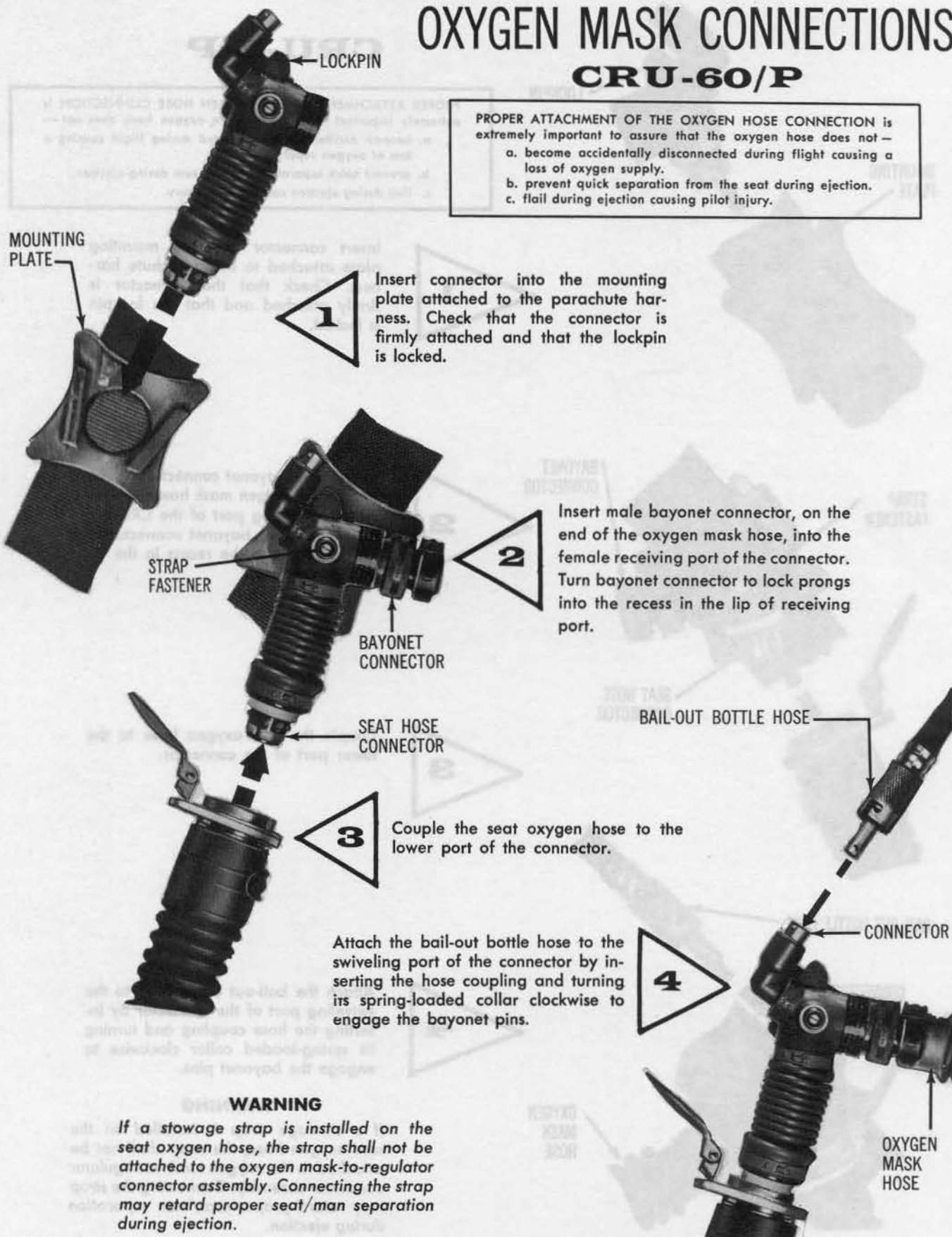
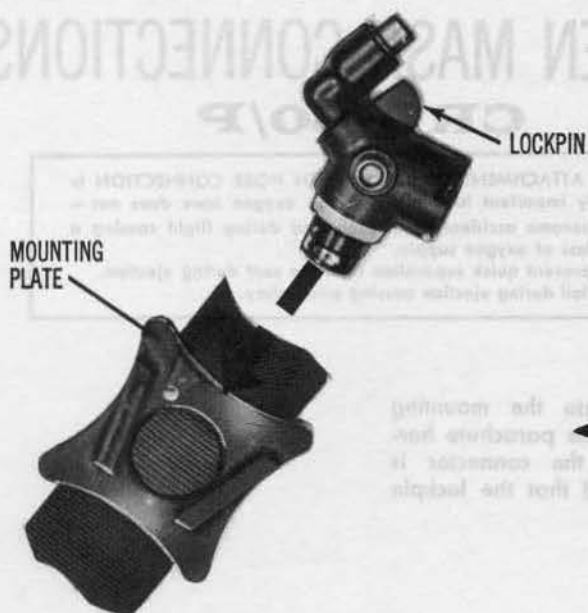


Figure 1-77 (Sheet 1 of 2)

CRU-8/P

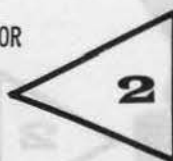


PROPER ATTACHMENT OF THE OXYGEN HOSE CONNECTION is extremely important to assure that the oxygen hose does not —

- become accidentally disconnected during flight causing a loss of oxygen supply.
- prevent quick separation from the seat during ejection.
- fail during ejection causing pilot injury.



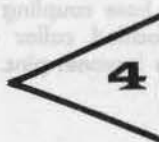
Insert connector into the mounting plate attached to the parachute harness. Check that the connector is firmly attached and that the lockpin is locked.



Insert male bayonet connector, on the end of the oxygen mask hose, into the female receiving port of the CRU-8/P connector. Turn bayonet connector to lock prongs into the recess in the lip of receiving port.



Couple the seat oxygen hose to the lower port of the connector.



Attach the bail-out bottle hose to the swiveling port of the connector by inserting the hose coupling and turning its spring-loaded collar clockwise to engage the bayonet pins.

WARNING

If a stowage strap is installed on the seat oxygen hose, the strap shall not be attached to the oxygen mask-to-regulator connector assembly. Connecting the strap may retard proper seat/man separation during ejection.

Figure 1-77 (Sheet 2 of 2)

Note

Above 30,000 feet, a vibration or wheezing sound, which may sometimes be noted in the mask, is a normal characteristic of regulator operation.

CAUTION

Always use 100% OXYGEN for take-off, landing, and during air-refueling to protect against possible cockpit air contamination.

Emergency Operation of Oxygen System.

See Hypoxia section III.

MISCELLANEOUS EQUIPMENT.**Note**

The anti-G and ventilated suit systems will be inoperative when the main hot air shutoff valve switch is OFF.

ANTI-G SUIT PROVISIONS.

An air-pressure hose in the personnel lead bundle at the front of the pilot's seat provides for the attachment of the air-pressure intake tube of the pilot's anti-G suit. Air-pressure for inflation of the anti-G suit bladder is conducted from the engine compressor through a pressure regulating valve located on the left console. The valve opens under a G loading of 1.5 to 2.0 G, and will allow pressure to be applied to the suit, increasing in direct relationship with the magnitude of G load imposed approximately as follows: at 2G from 0 to 1.2 PSI; at 4G from 2.9 to 4.2 PSI; at 6G from 5.85 to 7.3 PSI; and at 8G from 8.7 to 10.4 PSI. When the acceleration decreases below the valve opening G setting, the valve closes and exhausts the suit pressure into the cockpit. The relief valve will prevent the pressure in the suit from exceeding 11 PSI.

Note

In the event of excessive pressure and the anti-G system fails, disconnect anti-G suit hose. On unmodified G-suits, the check valve on the G-suit hose must be manually depressed to relieve the pressure.

Anti-G Suit Valve Test Button.

The anti-G suit valve test button (19, figure 1-6), is located on the left console. Depressing the button will simulate valve operation under G loading and cause pressure to inflate the anti-G suit bladder to assure operation.

PILOT'S LIQUID SUPPLY.

A one-quart thermos-type of liquid container is stowed in a bracket on the right of the upper center of the bulkhead, aft of the ejection seat in the  front and  cockpit, and in a bracket on the left of the upper center of the bulkhead aft of the ejection seat in the  rear cockpit. Attached to the container is a flexible tube with a hand valve at its end containing a pushbutton which must be depressed before the liquid in the container can be used. To drink the liquid from the container, detach the hand valve from the headrest, insert the drinking tube into the mouth, depress the hand-valve button and suck the liquid from the container.

PILOT'S RELIEF PROVISIONS.

The pilot's relief provisions (20, figure 1-6) consists of a horn, terminating in a removable pint container, which contains a spring-loaded double-action valve. The valve lever, which must be actuated before use provides for pressure equalization, usage, and air-escape. In the normal position of the valve, the air escape and usage sections are closed. The valve and bottle assembly is stowed in the aft left console. It is retained in position by the pressure of a sponge rubber pad attached to the receptacle base. After the lugs on the valve are inserted in the slots in the mounting hole, the assembly is turned counterclockwise to engage the lugs underneath the panel.

VENTILATED SUIT SYSTEM.

The ventilated suit provides air circulation around the pilot's body and is normally worn under an anti-exposure suit as a means of perspiration elimination. Air for the ventilated suit is taken from the cockpit into a blower and forced through a flexible hose in the personnel lead bundle at the front of the ejection seat. The vent suit blower is controlled by a switch on the temperature control panel. A manually operated flow control valve at the end of each hose permits adjustment of the airflow into the suit. A short section of hose attached to the suit, is connected to the hose from the personnel lead

SERVICING DIAGRAM

specifications

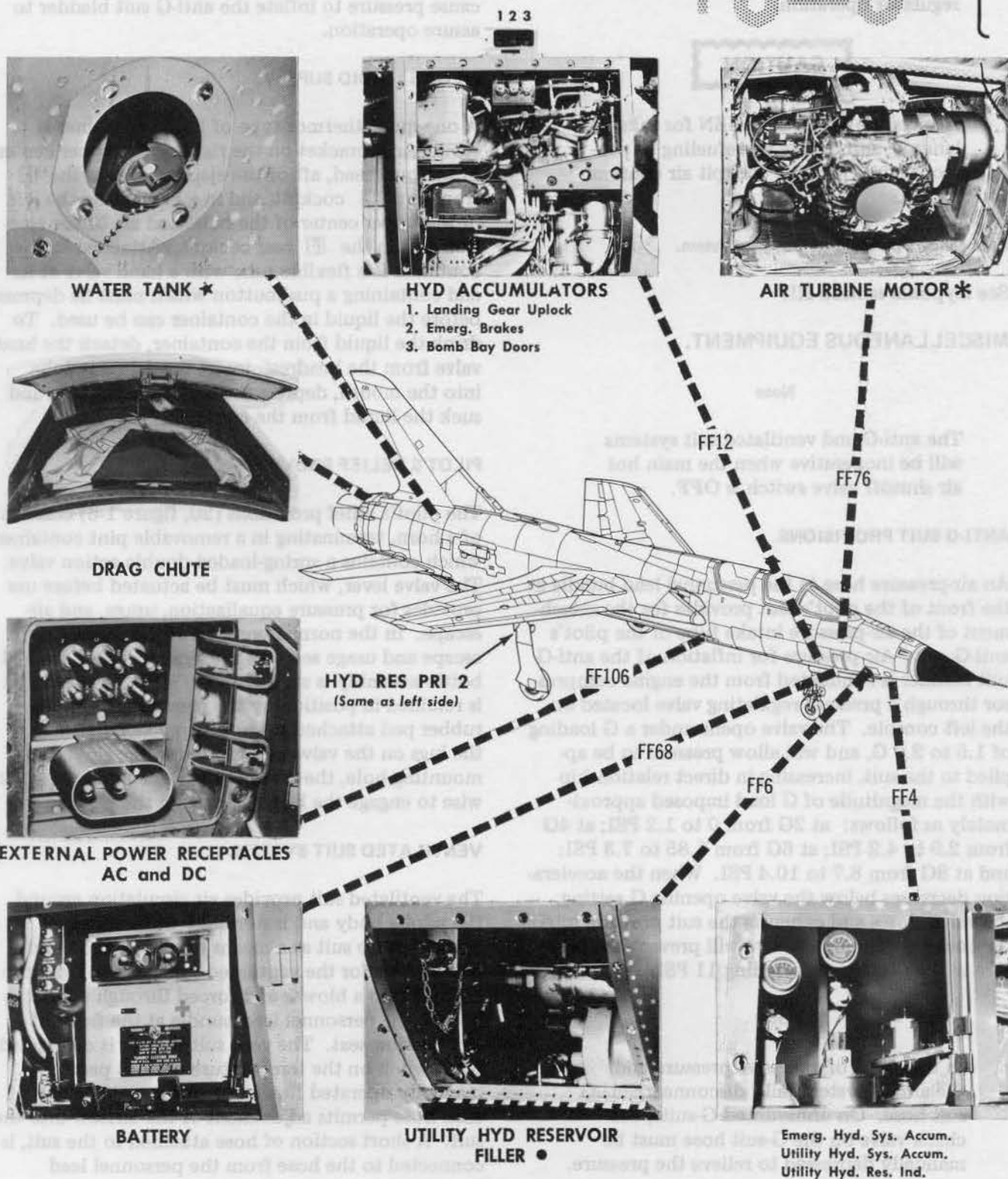


Figure 1-78 (Sheet 1 of 2)

▲ FUEL MIL-J-5624 (JP-4)

ALTERNATE See Section V

* OIL (TURBINE) MIL-L-23699

● HYDRAULIC FLUID MIL-H-5606

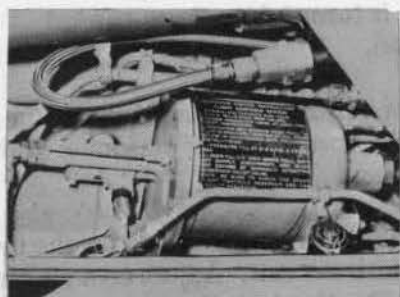
(NATO SYMBOL H-515)

■ OXYGEN MIL-O-27210

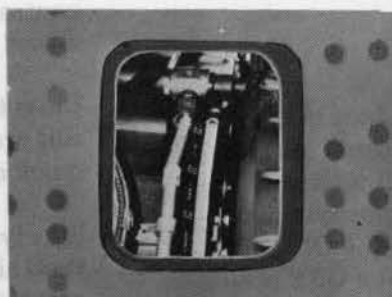
(REPLACES BB-O-925)

★ WATER

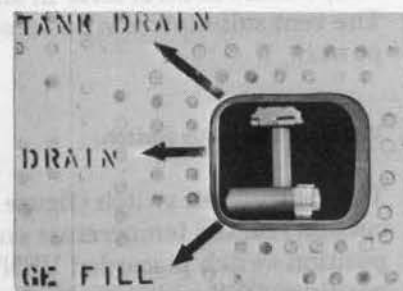
Purity factor of no more than 5 to 10 parts contamination (including minerals) in one million parts of water.



HYD RES PRIMARY 1 ●



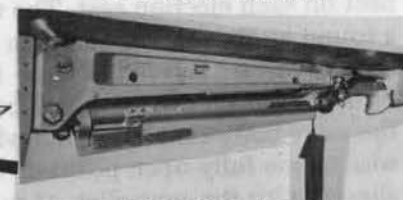
ENGINE OIL GAGE



ENGINE OIL GAGE SHUTOFF



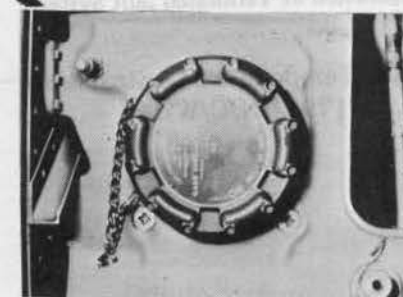
CARTRIDGE STARTER



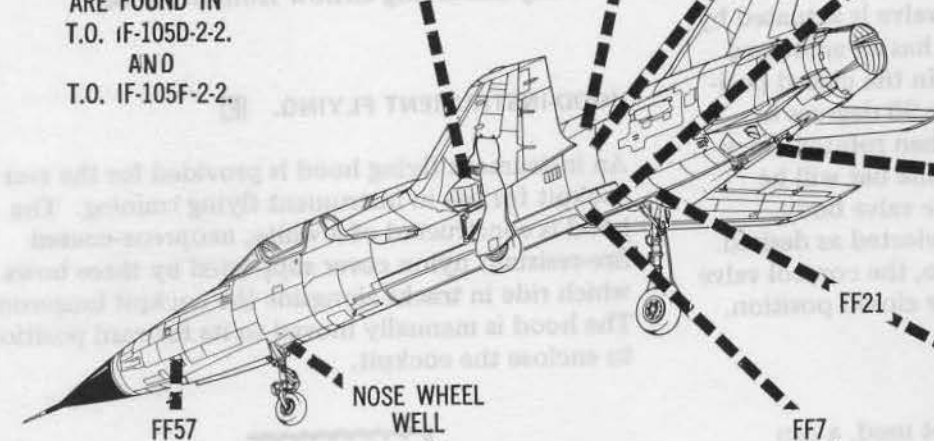
ARRESTING HOOK



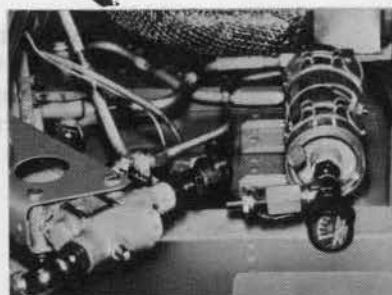
ENGINE OIL FILLER *

SINGLE POINT
GROUND REFUEL ▲

NOTE
SERVICING INSTRUCTIONS
ARE FOUND IN
T.O. 1F-105D-2-2.
AND
T.O. 1F-105F-2-2.



LIQUID OXYGEN ■



ANTISKID ACCUMULATOR

Figure 1-78 (Sheet 2 of 2)

disconnect. The temperature of the air to the suit is controlled automatically by the cockpit temperature control knob when the temperature control lever is at CKPT AUTO ON, and manually by the temperature control lever in any other position. The vent suit blower is powered by AC secondary power.

Ventilated Suit Air Switch.

The vent suit air switch (figure 1-71) (not in rear cockpit) on the temperature control panel is a two-position switch placarded VENT SUIT AIR with positions OFF and an unmarked ON position and is powered by AC secondary power. The ON position energizes the vent suit blower. The OFF position shuts the blower off.

Ventilated Suit Flow Control Valve.

The ventilated suit flow control varies the flow of air into each vent suit. The flow control valve is manually operated, and is located where the suit hose section joins the hose from the quick disconnect on each ejection seat. The valve is actuated by a round knob, the top of which has an embossed bar to indicate valve positions. In the closed position, the bar on the knob will be 90 degrees to the valve body centerline and when rotated clockwise to the fully open position, the bar will be aligned with the centerline of the valve body. Intermediate positions may be selected as desired. When the [F] is being flown solo, the control valve in the rear cockpit shall be in the closed position.

Note

If the vent suit system is not used, a cap may be installed on the hose end and the blower motor may not operate due to the secondary circuit breaker being pulled.

Operation of Ventilated Suit System.

1. Temperature Control lever — CKPT AUTO ON ([791] N/C/W).

2. Ventilated suit air switch — ON.
3. Feel for airflow from the hose coming from the personnel lead hose by opening the flow control valve.
4. Check for a decrease in airflow when the flow control valve is turned from open toward closed position.
5. Close the flow control valve and connect the suit hose to the hose from the personnel lead quick disconnect.
6. Slowly open the flow control valve for the desired airflow into the suit. Adjust cockpit temperature knob for the desired temperature in the ventilated suit.

Note

If the vent suit is not worn, the flow control valve should be closed to stop any disturbing airflow from the hose.

HOOD-INSTRUMENT FLYING. [F]

An instrument flying hood is provided for the rear cockpit for use in instrument flying training. The hood is constructed of a white, neoprene-coated fire-resistant nylon cover supported by three bows which ride in tracks alongside the cockpit longeron. The hood is manually moved to its forward position to enclose the cockpit.

CAUTION

Raising the rear seat in the F-105F aircraft to the full up travel, may cause the seat catapult yoke to contact the bungee chord brackets. To prevent this, do not raise the seat to the full up position.

Section II

NORMAL PROCEDURES

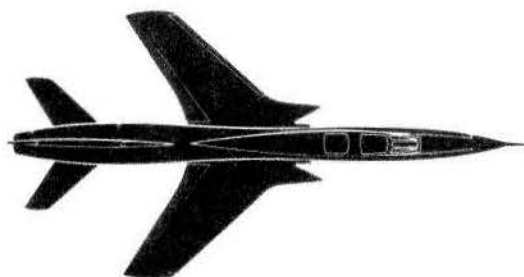


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PREPARATION FOR FLIGHT.

FLIGHT RESTRICTIONS.

Refer to section V of this manual for Operating Limitations of the aircraft.

FLIGHT PLANNING.

Determine takeoff, cruise control and fuel requirement data from the Appendix. Check armament and special equipment carried is suitable for the mission. Determine that survival kit provision container is appropriately supplied for the area of operations.

TAKEOFF AND LANDING DATA CARD.

Before each flight, refer to the Appendix for information necessary to fill out the Takeoff and Landing Data Cards, located in the Abbreviated Checklist T.O. 1F-105D-1CL-1.

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WEIGHT AND BALANCE.

Check takeoff and anticipated landing gross weight, refer to section V for limitations. Consult Handbook of Weight and Balance Data, T.O. 1-1B-40 and Form 365F for weight and balance requirements. Determine whether special fuel sequence is required due to disposable load.

F-105D PILOT — Shall accomplish all check list items except those identified by ☐ which are peculiar to the F aircraft.

F-105F PILOT (FRONT COCKPIT) — Shall accomplish all check list items except those identified by ☐ which are peculiar to D aircraft.

F-105F CREW MEMBER (REAR COCKPIT) — Shall, in conjunction with the pilot, accomplish all items identified by ☐ and monitor items identified by ✕.

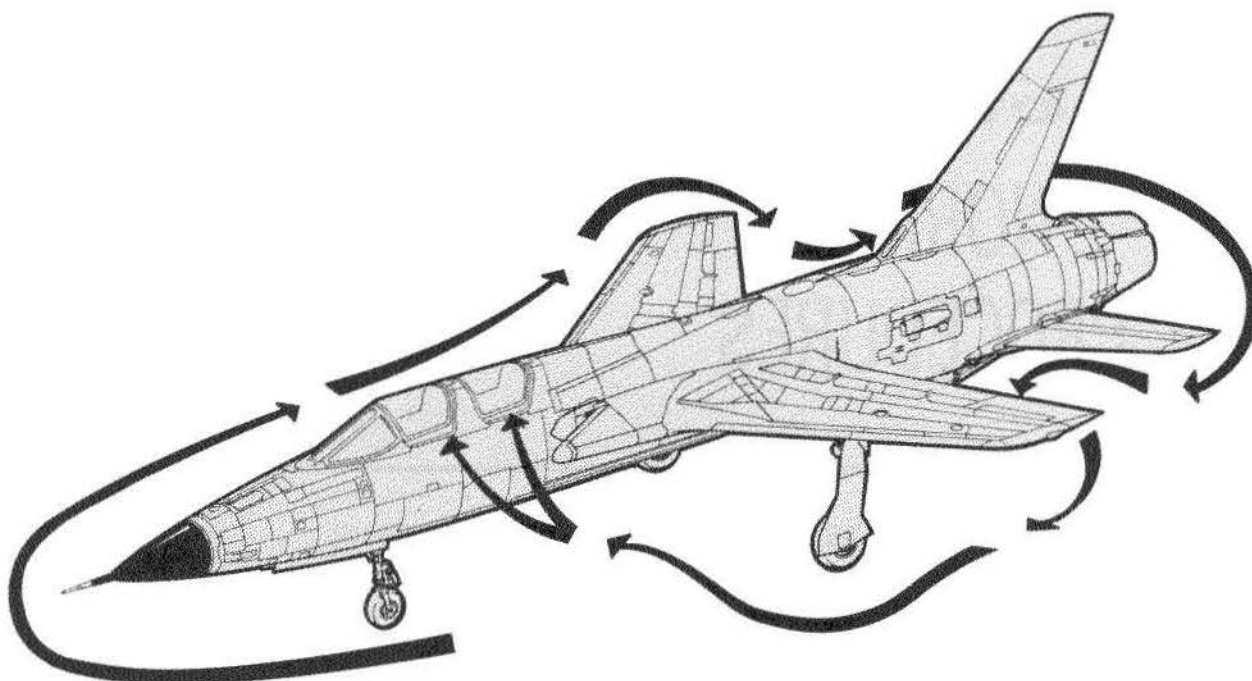


Figure 2-1

PREFLIGHT CHECK.**BEFORE EXTERIOR INSPECTION.**

1. AFTO Form 781 — Check.

Note

Spare cartridges may be carried in the right hand storage rack located on FF46 for a maximum of two flights and subsequently used. The status of spare cartridges can be determined by reference to AFTO Form 781, Part III.

WARNING

Assure there is no cartridge in the starter breech before proceeding with a pneumatic start.

- Flights with a live cartridge in the starter breech are prohibited.

EXTERIOR INSPECTION.

The exterior inspection (figure 2-1) is based on the fact the maintenance personnel have completed all requirements of the Technical Manual of inspection requirements for preflight and post flight:

Therefore duplicate inspections and operational checks of systems have been eliminated, except for certain items required in the interest of flight safety.

CAUTION

Exterior inspection should be accomplished before DC and AC external power is connected to the aircraft.

Note

Starting at the nose wheel of the aircraft, check all surfaces for cracks, distortion, loose or missing rivets, and indications of damage, signs of fuel, oil and hydraulic fluid leaks; check that all access panels are secured with the exception of those required to be open for after start inspection.

- At bases where ground personnel are not completely familiar with your aircraft, make sure that the post flight and preflight are accomplished in accordance with the Technical Manual of inspection requirements;
 - ☐ T.O. 1F-105D-6, 1D-105D-6WC-1 PRPO or -4PE
 - ☐ T.O. 1F-105F-6, 1F-105F-6WC-1 PRPO or -1PE

ENTRANCE TO AIRCRAFT



Place utility ladder against left side of the aircraft at the cockpit. No external grips or steps are provided. Unlock the canopy by using the exterior canopy lock lever and open the canopy by depressing the upper exterior canopy control button. When the canopy is open the ladder may be hooked over either cockpit rail.

Figure 2-2

AIRCRAFT SAFETY CHECKS.

Upon arrival at the aircraft, the pilot should perform the safety checks outlined below:

1. Nose gear torque links — Connected, pin installed and safetied.
2. Landing gear safety pins — Removed.
3. Fire extinguisher safety pins — Removed [1060] C/W.
4. Arresting hook safety pin — Insure removal.
5.  Canopy — Check for security.
6.  Seat leg brace safety pin — Installed.
7.  Aux canopy jettison handle safety pin — Removed.
8.  Seat quick disconnects, shoulder harness, communication leads and hose fittings — Check. Check seat quick disconnects for

proper connection of oxygen, radio, anti-G suit and vent suit. Check hose fittings on ejection seat catapult and canopy remover. Check that the shoulder harness straps are not laying over the back of the ejection seat or head rest. This can interfere with the seat adjustment and jam or damage the canopy actuator/remover and/or shoulder harness.

ENTRANCE TO AIRCRAFT.

For entrance to aircraft see figure 2-2.

[F] REAR COCKPIT CHECK — SOLO FLIGHTS.

For solo flight the pilot must check the rear cockpit as follows:

1. Left console circuit breakers — IN.
2. All switches on left console — OFF or normal position.
3. Fuel shutoff switch — ENGINE FEED (guard down and safety wired) [1044] C/W.

4. Speed brake switch — Check centered.
5. Throttle idle stop — Check disengaged (down).
To disengage, depress and rotate 90° CCW.
6. Arresting hook switch — UP and guarded.
7. Landing gear handle — DOWN.
8. Armament control panel — Set.
 - a. Master-armament switch — OFF (guard down).
 - b. Station-selector buttons — OUT.
 - c. Pylon-sequence-selector switch — OFF.
9. Compass control panel function selector knob — SLAVED.
10. Oxygen supply lever — OFF.
11. All switches and controls on right console — OFF or normal position.
12. Right console circuit breakers — IN.
13. Special weapon lock — Handle forward, pip pin installed, unless otherwise directed. Pip pin removed for bomb bay carriage — Ground alert.
14. Consent panel lock switch — UNLOCK unless otherwise directed.
15. Consent panel arming switch — ARM unless otherwise directed.
16. Vent suit flow control valve — Closed if installed.
17. Seat leg brace and canopy safety pins — Installed.
18. Survival kit secured with nylon tie down ropes or if not available, remove survival kit.
19. Parachute (if in seat) — Disconnect from actuator, install safety pin and dust cap and remove parachute from cockpit [1038] C/W.
20. Control stick and rudder pedals — Check free and clear of obstructions.
21. All loose items — Stowed and secured.

- a. Place pilot's personal leads on top center of survival kit with ends pointing aft.
- b. For solo flights, attach the leg restraint keys and shoulder harness to the lap belt, lock and draw lap belt snug across survival kit. Secure the nylon ropes to the leg restraints to preclude entanglement with any controls.

WARNING

An improperly secured survival kit could become separated from the seat and become wedged between the seat and the control stick.

- c. Navigation (goose neck) light — Secured in snap holder.
- d. Map case — Secured.
- e. Plotting board — Secured.
- f. Relief container — Secured.
- g. C-4 Utility Light — Stowed in its socket.
22. Aft canopy — Close and lock.

Ⓢ REAR COCKPIT CHECK — PASSENGER OTHER THAN CREW MEMBER.

When carrying a passenger other than a crew member the pilot must perform the rear cockpit check as in solo flights and also instruct the passenger in the following:

1. Aux canopy jettison handle safety pin — Insure removal.
2. Proper hook-up of shoulder harness, safety belt, survival kit and personal leads.
3. Use of vent suit flow control valve (if applicable).
4. Seat height and rudder pedal — Adjusted.
5. Hook-up and disconnect of the zero delay lanyard [1038] N/C/W.
6. Connection of parachute firing cable to parachute deployment gun actuator [1038] C/W.

Note

A force of 16 to 20 pounds is required to seat the parachute firing cable end fitting in the actuator.

7. Use of the intercom set.
8. Ejection and evacuation of the aircraft — Briefing received.
9. Removal and stowage of seat leg brace safety pin.
10. Location of critical switches — Check.
 - a. ENGINE FEED [1044] C/W.
 - b. Jettison external stores button.
 - c. Consent panel lock/arming switches.
 - d. Oxygen panel switches.
 - e. Radar/beacon switch.
 - f. Compass control panel function selection knob.

COCKPIT CHECK — ALL FLIGHTS.

1. All electrical power — Check OFF.
2.  Enter cockpit, adjust rudder pedals and attach and secure all personal equipment.

Note

If desired, a preflight operational check of the inertial locking feature of the shoulder harness inertia reel can be made after the handle has been set in the UN-LOCKED (aft) position. Pull rapidly on the harness; the reel should lock. To make sure the reel has not fully extended, move the handle forward to LOCKED then back to UNLOCKED. The harness shall release and be capable of further extension.

- a. Connect left and right survival kit parachute attaching straps.

Make sure that the survival kit fasteners are properly positioned and the straps are pulled tight.

- a1. Lace left leg lanyard under left leg, insert through right garter D-ring going from aft to forward then place lanyard ring on safety belt survival link [1083] C/W.
- a2. Lace right leg lanyard under right leg,

insert through left garter D-ring going from aft to forward then place lanyard ring on safety belt survival link [1083] C/W.

- b. Place right shoulder harness loop on safety belt swivel link.
- c. Place left shoulder harness loop on safety belt swivel link.
- d. Place parachute lanyard anchor on safety belt swivel link and fasten safety belt [1038] N/C/W.
- e. Fasten safety belt. Remove safety pin and dust cap from parachute firing cable and connect firing cable to parachute deployment gun actuator [1038] C/W.

WARNING

The force-deployed parachute contains a ballistically fired deployment gun. Extreme caution shall be exercised any time parachute is handled. Ensure that safety pin, streamer, and dust cap are always engaged in cable assembly to prevent deployment gun being discharged when cable assembly is not connected to actuator on ejection seat. Hold parachute so that barrel of deployment gun points away from all personnel and towards a suitable parapet in case of discharge.

Note

A force of 16 to 20 pounds is required to seat the parachute firing cable end fitting in the actuator.

- f. Leave shoulder harness control handle UN-LOCKED and adjust safety belt and shoulder harness.

Note

Proper adjustment of the shoulder harness:

- Straps adjusted snug but not tight.
- Yoke resting comfortably at the back of the neck.
- g. Connect personal leads: Route oxygen and radio leads under the lap belt and under the left leg to the aircraft anti-G suit connection. When connecting helmet oxygen

hose to the parachute, route the hose underneath the right shoulder harness strap.

WARNING

Failure to attach personal equipment correctly may prevent separation from the seat after ejection. Refer to figure 1-64.

- If the anti-G suit hose is routed over the lap belt, the lap belt will probably be unlatched by the G-suit hose attachment during seat separation. This will eliminate the automatic feature of parachute deployment [1038] N/C/W. Insure that the hose will not interfere with operation of the ejection seat.
 - Whenever a pressure suit is not worn, be sure the pressure suit vent hose is secured so it cannot become wedged between the seat and control stick.
 - After the shoulder harness is properly adjusted, assure that the loose ends are secured to the shoulder harness webbing and that all other loose strap ends are also secured in order to lessen the possibility of seat/man entanglement during ejection.
 - If a stowage strap is installed on the seat oxygen hose, the strap shall not be attached to the oxygen mask-to-regulator connector assembly. Connecting the strap may retard proper seat/man separation during ejection.
- [E] 3.  Bail out light switch — Check then OFF. When dual check that bailout lights illuminate with actuation of the bailout light switch in each cockpit.
4.  Zero delay lanyard — Connect to rip-cord grip [1038] N/C/W.
5.  Parachute firing cable — Check connected.
6.  Control stick grip — Check for security. There will be a slight movement of the force-switch housing.
7.  Left side circuit breakers — IN and fuse-holders — TIGHT.
8.  Intercom control panel — Set.
- a. Function-selector switch — COMM.
 - b. Normal auxiliary switch — NOR.
9. Alternate engine fuel feed switch — AUTO-MATIC [1061] C/W.
10. Temperature control panel — Set.
- a. Electronic cooling switch — ON.
 - b. Pitot heat switch — OFF.
 - c. Cockpit temperature knob — 12 o'clock position.
 - d. Temperature control level — RAM. Check lever for free movement.
 - e. Rain removal switch — OFF.
 - f. Vent suit air switch — OFF.
 - g. Forward windshield defogging switch — OFF.
 - h. Windshield side panel defroster knob — OFF (ON second detent for ground alert).
 - i. Engine DE-ICE switch — OFF.
 - j. Camera mount switch — AUTO [1018] C/W.
11. Fuel system control panel — Set.
- a.  Fuel tank selector switch — MAIN TK (MAIN).
 - b. Boost pump switches — OFF (ON for ground alert).
 - c. Centerline (Belly) Tank Jettison Switch — Guard down [997C and 1044] N/C/W.
 - d.  Fuel shutoff switch — ENGINE FEED [997C or 1044] C/W.
 - e. Signal amplifier override switch — NORMAL.
 - f. Air refueling lights rheostats — OFF.

12. Flight control panel — Set.

- a. RAT lever — TURB RETRACT.
- b. VAI switch — CRUISE.
- c. Pitch mech adv switch — ON.
- d. Stick-grip override switch — NORMAL.
- e. Stabilizer lock switch — NORM (guarded)
[1045] C/W.
- f. Flap roll control switch — CRUISE
[1049] C/W.

13. Radio — OFF (ON and set for ground alert).

14. Radar Control Panel (left console) — Set.

- a. Fire control system power — OFF.
- b. Radar mode buttons — GRD MAP
PENCIL.
- c. Antenna tilt — FULL UP.
- d. Receiver gain — FULL OFF.

15. Throttle quadrant — Set.

- a. Throttle — OFF, check friction lock OFF.
- b. Speed brake switch — IN.

[F] • Rear cockpit — Check switch is centered.

- c. ✕ Flap lever — LE & TE FLAPS UP
(LANDING & TAKEOFF for ground alert).
- d. A/B throttle stop — NORMAL.

16. Emergency control panel — Set.

- a.  Emergency fuel system switch — OFF.
- b. Water injection switch — OFF.

17. TBC controls — Set.

- a. Burst height knob — Set.
- b. Target altitude knob — Set.
- c. IP altitude knob — Set.

d. IP range knob — Set

e. IP bearing knob — Set.

18. Left auxiliary instrument panel — Set.

- a.  Landing gear handle — DOWN.
- b. Landing gear downlock override switch —
Check for click.
- c. ✕ Arresting hook switch — UP and guarded.
- d. Antiskid switch — OFF.
- e. Landing and taxi light switch — OFF (taxi
light ON for ground alert).
- f. Drag chute handle — IN.
- g. Landing gear emergency extension handle —
IN.

19. Sight caging knob — CAGE.

20. ✕ Standby airspeed indicator — Check.
Pointer should be vertical.21. Armament control panel — Set.

- a.  Bomb-bay-station-selector button —
OUT, guard set.
- b.  Master armament switch — OFF.
- c.  Weapons selector knob — GUNS —
AIR.
- d.  Bomb-mode-selector knob — MAN.
- e. Depressed reticle knob — OFF.
- f.  Bomb-arming switch — SAFE.
- g.  Bomb-Nav switch — NAV.
- h.  Bomb mode gyro erection button —
Push IN.
- i.  Pylon-station-selector buttons —
OUT.
- j.  Pylon sequence selector switch —
OFF.

22. Air refuel handle — IN.

23. Video pedestal — FULL CCW.
24. Special weapons control panel — SET.
25. DCU-59/A or DCU-102/A Option Selector — OFF (if applicable), control arm sealed if special weapon is installed.
26. Pedestal armament panel circuit breakers — IN.
27. Auxiliary special weapon release handle — IN.
28.  Emergency brake handle — IN.
29.  Flight instrument failure simulate and radar scope deactivate switches — As required.

Dual — NORM and NORM.

Solo — SIMULATE FAILURE and DEACTIVATE.
30.  Clock — Set and check.
Check stop watch action.
31.  Navigation (gooseneck) light — As required.

Note

Navigator light positioned and ON for night flights. Light powered by battery (primary DC) and is useful during night start engine procedure.

32. AC/DC electrical power supply control panel — Set.
 - a. Inverter switch — STANDBY.
 - b. AC generator switch — OFF.
 - c. DC generator switch — ON.
33. Jettison inboard MER switch — OFF.
34. Main hot air line shutoff valve switch — MAIN AIR LINE.
35. Bomb-bay door auxiliary handle — OFF.

If handle is in the OPEN position, check with crew chief, then place it in the CLOSED position until the bomb-bay doors close; then return it to OFF.

Note

When flying with centerline tank installed, the bomb bay station selector button will be out with the guard safetied in the locked position and the bomb bay door auxiliary handle safetied in the OFF position.

36.  Special weapon lock — LOCKED (forward) and pip pin installed. (Safetied, sealed for bomb bay carriage ground alert.) Rear cockpit-Locked-Pip pin inserted, safetied, sealed (2-man, bomb bay carriage).

WARNING

When carrying the MN-1A/SUU-21A or equivalent Practice Dispenser or a 390-gallon fuel tank in the bomb bay, the special weapon lock handle (in both cockpits of the F) will be left in the locked (full forward) position with the pip pin installed.

37. Radar control panel (right console) — Set.
 - a. Memory knob — FULL OFF (knob full CCW).
 - b. Intensity — FULL UP (knob full CW).
 - c. Bezel brilliance — FULL UP (knob full CW).
 - d. Altitude set — FULL OUT (knob full CCW)
 - e. Cursor brilliance — FULL UP (knob full CW).
 - f. Clearance calibration — Knob FULL CCW.
 - g. Clutter eliminator — OFF.
 - h. Radar/Beacon — RADAR.
38.  All navigation equipment — OFF. (Doppler heading reference switch — MAG for ground alert.)

Check that IFF/SIF, Doppler, ILS and TACAN are OFF. The IFF/SIF control panels are not in the rear cockpit.

39.  Compass system function selector switch — SLAVED.

- [E]** 40. Strike camera — OFF [F516C, F-522] C/W.

41.  Interior and exterior lights — As required.
42.  Right side circuit breakers — IN, fuse holders — TIGHT.

Check circuit breaker panels, aft end of right console, and above right console.

43. Battery switch
— OFF (with ext power).
— ON (for battery start).

For external electrical power, connect DC power first, then AC.

44. Oxygen system — Check.

- a. Oxygen supply lever — ON, safetied.

- [E]**  (Rear cockpit oxygen supply lever — ON, no safety.)

- b. Oxygen quantity — Check.

Refer to section I for oxygen system pre-flight and oxygen duration chart.

- c.  Oxygen diluter lever — 100%.

- d.  Oxygen emergency lever — NORMAL.

- e. ✕ Oxygen low light system — TEST.
Depress and hold oxygen warning test button. Check gage for oxygen quantity decrease. When the needle reaches one liter or below, the oxygen low level light will illuminate. Release button; needle should return to original gage reading, and oxygen low-level light will go out.

45. Control transfer panel test lights button — Depress and check.

All six take over buttons shall illuminate while button is depressed. The six rear cockpit buttons shall be illuminated since control is in the front cockpit.

46. Air line overheat sensing system — Test.

Depress and hold the air line overheat sensor test button. Check that the main hot air line o'heat and ATM air line o'heat and master caution lights illuminate. Release button and lights will go out.

47. Battery high charge and high voltage caution lights — Check [955] C/W.

48. ✕ Fuel quantity indicator — Check quantities and select INTERNAL TOTAL.

- a. Fuel quantity indicator test button — Depress and hold. All indicators should move toward zero.
- b. Fuel quantity indicator test button — Release. The indicators should return to original position.

49. ✕ Fire and overheat warning lights — Check.

50. Station selector buttons light test button — Depress and check.

All station selector buttons shall illuminate while LAMP TEST button is depressed.

51. ✕ Landing gear warning test button — Depress and check.

The following indications shall occur while button is depressed:

- The red light in the gear handle illuminates.
- The warning beeper is heard on the inter-phone.
- The three UNSAFE gear position indicators illuminate.

Note

If start is not made immediately, the fuel selector and then the battery should be turned OFF.

DANGER AREAS

APPROXIMATE JET WAKE TEMPERATURE AND VELOCITY

J75-P-19W engine

CODE

ENGINE DANGER AREA



RADAR DANGER AREA

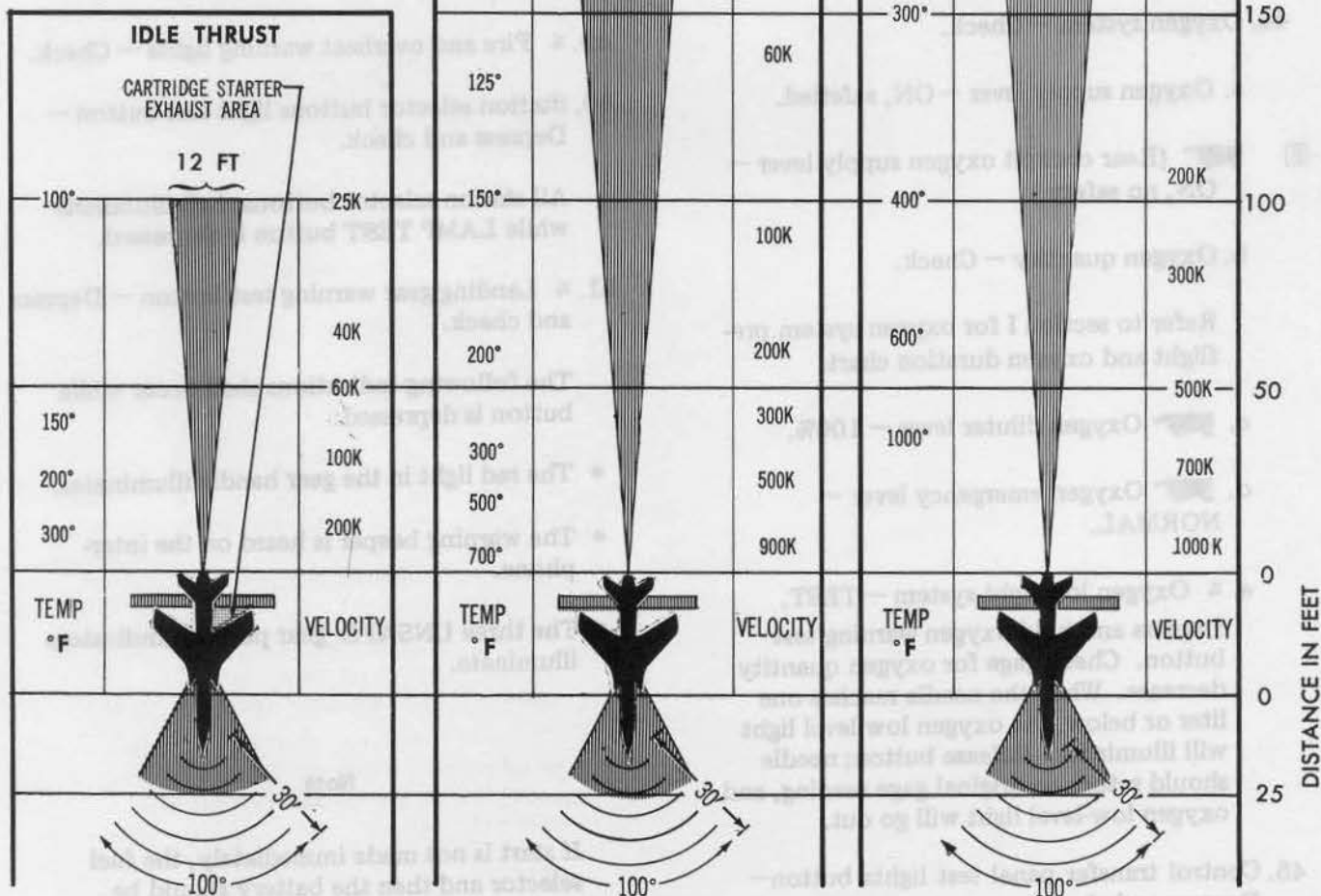


Figure 2-3

BEFORE STARTING ENGINE.

Before starting the engine, make sure that danger areas fore and aft of the aircraft are clear of personnel, aircraft, and vehicles. (See figure 2-3.)

Refer to section V for starting exhaust gas temperature limits.

DEFINITIONS.

HOT START—Indicated by exhaust gas temperature exceeding starting temperature limit. A hot start can sometimes be anticipated when the throttle is placed in IDLE and fuel flow indication is greater than normal for the field elevation.

FALSE START—Indicated by RPM not increasing to IDLE and exhaust gas temperature remaining within limits.

FAILURE TO START—Indicated by no rise in exhaust gas temperature within 10 seconds, no continued increase in RPM, fuel flow abnormally low and no sound indicating fuel has ignited.

CARTRIDGE MALFUNCTIONS.

MISFIRE—Failure of the cartridge to ignite.

HANGFIRE—Abnormal delay between ignition of the cartridge and establishment of even burning pressure. Indicated by little or no positive indication of RPM and black smoke coming from the starter exhaust.

WARNING

When a misfire or hangfire occurs, the cartridge must be removed before a pneumatic start is attempted. The engine must not be started nor the aircraft flown with a live cartridge remaining in the starter breech.

- When a misfire or hangfire is encountered the starter breech will not be opened until 15 minutes have elapsed and no smoke is emitting from the starter exhaust duct.

STARTING ENGINE.**WARNING**

Do not start engine until assured that all personnel are clear of starter exhaust area, turbine plane, jet wake and air inlets. See figure 2-3.

- If the primary 1 and primary 2 hydraulic systems do not reach full system pressure (2850 to 3150 PSI) immediately after start the engine should be shut down. If the utility hydraulic system does not reach full pressure (2850 to 3150 PSI) immediately after ATM start, the ATM should be shut down. These actions will preclude possible damage to the hydraulic pumps.

1. Fuel tank selector switch — Recheck MAIN TK (MAIN).

If the fuel tank selector switch [997C and 1044] N/C/W, is moved from the OFF position with DC power on, wait 3 seconds with the switch in the first unmarked detent position to prevent relay arcing damage, then select MAIN TK.

2. Fuel shutoff switch — Recheck ENGINE FEED [997C or 1044] C/W.
3. Throttle — Recheck OFF.
4. Battery switch, recheck
— OFF for external electrical power.
— ON for battery start.

Note

[E] Battery switch and cartridge start button not in rear cockpit.

- 5.a. *Pneumatic start*, signal crew chief to supply air, when tachometer indicates 12 percent RPM, air start button — Depress, throttle — IDLE.
- b. *Cartridge start*, cartridge start button — Depress until positive indication of RPM, when tachometer indicates 8 percent RPM, throttle — IDLE.

CAUTION

Do not hold cartridge start button depressed above 10 percent RPM as the squib actuated gas bypass valve in the starter may fire.

CAUTION (continued)

The ignition cycle is initiated when the start button is depressed and continues for 20 seconds after the start button is released. However, ignition is not supplied to the engine igniter plugs unless the throttle is out of the OFF position.

6. Fuel flow — Check for positive flow.

If fuel flow exceeds 1800 PPH, anticipate a hot start.

7. Exhaust gas temperature — Check rise within 10 seconds (400° C max).

If the engine does not light up within 10 seconds as evidenced by no rise in EGT, no continued increase in RPM, or fuel flow is abnormally low, abort the start, throttle — OFF. Follow unsatisfactory start procedure.

8. Oil pressure — Check rise.

Oil pressure should increase steadily to 35 PSI minimum.

Oil pressure caution light should go out before 45 PSI is attained.

Oil pressure may indicate up to 100 PSI at idle RPM when MIL-L-23699 is used but will return to the 40 to 50 PSI range as the engine oil warms up. This higher viscosity, while cold, is a characteristic of MIL-L-23699 oil.

9. *Pneumatic start* — At 30 percent RPM, signal crew chief to shut off air, disconnect air source and close starter access door.

10. ATM switch — START.

At 50 to 55 percent RPM, hold to START until utility hydraulic pressure stabilizes 2850 PSI to 3150 PSI.

11. Idle RPM — 68 to 71 percent.

RPM should increase steadily, within one minute, to 68 to 71 percent without RPM hang up. Exhaust gas temperature shall reduce, to or below 340° C. If engine RPM does not increase within limits, the aircraft should be aborted.

12. If external power used — Signal crew chief to disconnect power, battery switch — ON.

CAUTION

AC power must be disconnected before DC power.

13. AC generator switch — RESET, then ON.

14. Engine instruments — Check.

UNSATISFACTORY START.

1. Throttle — OFF.

Close throttle immediately to prevent fuel flooding engine.

Note

[F] If idle stop in the rear cockpit is engaged (up) it will require approximately 30 lbs of pressure to move the throttle to OFF.

2. *Pneumatic start* — Signal crew chief to shut off air supply after one minute.

3. Fuel tank selector switch — OFF at 0 percent RPM [997C and 1044] N/C/W.

4. Fuel shutoff switch — SHUTOFF at 0 percent RPM [997C or 1044] C/W.

5. Battery switch — OFF, or disconnect external power.

Aft tailpipe section and fuel overboard drain line must be inspected for excess fuel. If no fuel is visible either on shroud or tailpipe, a second start may be attempted. Approximately 15 minutes will be required for drainage to be accomplished.

WARNING

If start was aborted, do not inspect inside tailpipe until engine and tail pipe are cool.

Note

A minimum five minute waiting period must be observed before attempting a new start.

Note (continued)

- A maximum of three pneumatic starts may be made in a 15-minute period.
- Cartridge and pneumatic starts may be interspersed. The total number of starts is limited to three in a 15-minute period, however, the limit of two cartridge starts in a 60-minute period must be adhered to.

CLEARING ENGINE.

If it is necessary to clear the engine of trapped fuel or vapors, use pneumatic starter unit and proceed as follows.

1. Throttle — OFF.
2. Fuel tank selector switch — MAIN TK (MAIN).
3. Battery switch or external DC power — ON.
4. Signal crew chief to supply air.
5. Crank engine above 12 percent RPM for one minute.
6. Signal crew chief to shut off air.
7. Fuel tank selector switch — OFF at 0 percent RPM [997C and 1044] N/C/W.
8. Fuel shutoff switch — SHUTOFF at 0 percent RPM [997C or 1044] C/W.
9. Battery switch or external DC power — OFF.
10. Allow additional 15 minutes for fuel drainage.
11. Re-inspect for residual fuel. Repeat procedure as necessary until all fuel is removed.

ENGINE GROUND OPERATION.

Engine warmup is not required under normal operating conditions. When operating the engine on the ground, keep the speed brakes in the closed position as much as possible to prevent undue circulation of hot gases throughout the fuselage and the fin ducts. Refer to Ground Operating Limits, section V.

WARNING

If EGT or RPM exceeds limits listed in section V, corrective action will be taken before flight or subsequent engine run-up.

- If the throttle is inadvertently retarded to the OFF position, do not reopen it to regain the light. The normal starting sequence must be repeated for each start. Introducing unburned fuel into the engine may create a fire hazard.

Note

High surface tail winds may cause speed brake flutter which is felt by the pilot as a rumble. Advancing the throttle or facing aircraft into the wind will eliminate fluttering.

BEFORE TAXIING**Note**

All hand signals will be initiated by the pilot and acknowledged by the crew chief.

- Steps followed by an (*) may be accomplished in the Before Taking Runway Check if the parking/starting area is congested.

1. Left side circuit breakers — Recheck.
2. Windshield rain removal switch — OFF.
3. Excess fuel venting indicator — Test.

Depress excess fuel venting indicator test button until excess fuel venting light illuminates (15 to 20 seconds).

4. Boost pump switches — ON.
5. Radio — ON.

Place function switch to the BOTH position and allow approximately 2 minutes warm-up before changing channels.

6. Fire control system power — STBY and GRD MAP PENCIL (*).

CAUTION

Memory knob should be rotated fully CCW before turning the fire control power switch to ON or STANDBY. This will prevent scope blooming and possible scope damage.

F 7. Idle stop — Check.

Order crew member to check idle stop engaged. To engage, rotate 90° CW and release.

8. Emergency fuel control system — Check.

a. Throttle — IDLE.

b. Emergency fuel system switch — EMER FUEL SYSTEM.

Ignition may be heard in the headset. Emergency fuel system caution light and master caution light should illuminate.

c. Check for a 20 second duration buzz in the head set which indicates ignition is being supplied.

d. Throttle — IDLE (68 to 78 RPM)

e. Emergency fuel system switch — OFF.

f. Emergency fuel system caution light and master caution light — OUT.

9. Antiskid — Check then OFF.

Apply moderate-to-heavy brake pressure on one brake pedal. Check for pedal pulse when turning antiskid on to indicate energized antiskid system. Turn off antiskid and duplicate check for other brake.

Note

If pedal pulse is not felt have crew chief check for pulse in brake line or brake discs on landing gear.

- If pedal pulse is not felt, have crew chief check that antiskid fail-safe system is reset.

10. ✕ Caution light panel — Test.

11. ✕ Standby inverter — Check then STANDBY.

a. Inverter switch — OFF.

Observe the AC GEN & INVTR and master caution light illuminate.

b. Inverter switch — Check and hold.

Observe that AC GEN & INVTR, and master caution lights go out and the ADI and HSI instrument displays are normal with some oscillation.

c. Inverter switch — STANDBY.

ADI and HSI indications should be normal and caution lights out.

12. ✕ Displacing gear pressure indicator — Check within limits.

If a fuel tank or MN-1A practice bomb dispenser is installed in the bomb bay, pressure indicator should read below 25 PSI.

13. ✕ CADC, VAI (TBC is applicable) — Check (*).

CAUTION

When actuating the CADC self-test switch to either high or low test position, it is important that all tapes be allowed to stabilize before releasing the switch to prevent damage to the CADC.

a. AVVI barometric pressure — Set at 29.92.

b. VAI switch — AUTO.

c. CADC self-test switch — Hold to LOW.

Pitch MA caution light on  should illuminate, on  the light may or may not illuminate. The vertical scale instruments should stabilize and indicate as follows:

Altitude: 11,806 feet (± 375).
 C.A.S.: 547 knots (± 14).
 Mach number: 0.994 (± 0.025).
 Acceleration scale: 1.0 (± 0.4) G.

The vertical velocity will indicate aircraft climb until the altimeter stabilizes, then return to zero. Allowable oscillation (± 2000 feet).

d. Check that duct plugs remain full aft.

e. TBC — Check (*).

f. CADC self-test switch — Release.

All vertical scale instrument readings should return to normal. Calibrated airspeed moving scale can read anywhere below 80 knots.

The following check is required for all supersonic flights.

g. CADC self-test switch — Hold to HIGH.

h. VAI switch — EMERG while plugs are moving forward.

Plugs should stop moving and lock in their present position and bleed doors open fully.

i. VAI switch — CRUISE.

The plugs should move full aft and the bleed doors close fully.

j. VAI switch — EMERG.

The plugs should remain full aft and the bleed doors will open fully (indicated by slight utility pressure surge).

k. VAI switch — AUTO.

Observe plugs move full forward and vertical scale instruments in both cockpits stabilize and indicate as follows: Check bleed doors closed to four degrees open.

Altitude: 50,740 feet (± 675).
 C.A.S.: 519 knots (± 14).
 Mach number: 1.980 (± 0.035).
 Acceleration scale: 1.0 (± 0.4) G.

The vertical velocity will indicate aircraft climb until the altimeter stabilizes, then return to zero. Allowable oscillation (± 2000 feet).

l. CADC self-test switch — Release.

All vertical scale instrument readings should return to normal and duct plugs move full aft. Calibrated airspeed moving scale should indicate anywhere below 80 knots.

WARNING

Do not use the CADC self-test switch in flight. Systems affected by the test may cause control difficulties if the switch is actuated in flight.

m. Check that duct plugs return full aft.

14. VAI switch — CRUISE (*).

15. Navigation equipment — Set.

a. IFF/SIF — STDBY (*).

b. Doppler — ON (*).

A minimum of one minute is required for the Doppler to warm up prior to slewing (adjustment).

Note

 If solo, the NAV take-over button does not have to be depressed to take control of the Doppler.

 If dual, and the rear pilot wants control, he must place the doppler heading reference switch at MAG or DG, and then depress the NAV take-over button.

c. ILS — ON (if applicable).

d. TACAN — T/R (*).

*If parking/starting area is congested these steps may be accomplished in Before Taking Runway check.

16. ✕ Interior and exterior lights — As required.

17. Right side circuit breakers — Recheck.

18. ✕ Integrated flight instruments — Check.

- a. AMI/AVVI — Check that warning flag is out of sight, command markers set as desired, and vertical velocity index is zero.
- b. ADI/standby attitude indicator — Check that warning flag is out of sight, and that sphere erects in approximately 2½ minutes after application of AC and DC power.
- c. HSI — Compass card stabilized, heading marker and course selector as desired.

19. ✕ AFCS — Check (*).

Note

Feet should be off rudder pedals for entire AFCS check.

- Tolerances are based on a 20-minute warm-up period.

a. Stab-aug check.

Stab-aug button — Depress, check stab-aug off caution light-out and control movement is not excessive.

Control surface movement shall not exceed:

Stabilizer: ¼ degree up or down.
Rudder: 1 degree left or right.
Spoilers: no movement.

b. Autopilot (Pilot Relief) — Check.

(1) Autopilot button — Depress.

Control surface movement shall not exceed:

Stabilizer: ¼ degree up or down.
Rudder: 1 degree left or right.
Spoilers: 2 degrees. If the aircraft is not level laterally, the automatic trim will cause lateral stick and control surface motion due to the gyro platform sensing an out of wings level condition, and applying signals to the auto-pilot to return the aircraft to wings level.

(2) Altitude switch — Engage.

There should be no stabilizer movement.

(3) Mach switch — Engage.

The altitude switch should disengage; there should be no stabilizer movement.

(4) Actuate either pitch force switch in the control stick.

Mach-hold should disengage. Check that the Mach switch cannot be re-engaged for at least 1.5 to 2.5 seconds after releasing force switch.

(5) Mach switch — Engage.

(6) G-limit test button — Depress.

Control stick will bump sharply and all AFCS functions will disengage. The stab-aug off caution light will illuminate.

(7) Stab-aug button — Depress, check stab-aug off caution light-out.

(8) Autopilot button — Depress.

Control surface movement shall not exceed limits in step b(1) above.

(9) Stick-grip pitch-trim switch — Actuate without actuating fore and aft force switches.

Stabilizer should move rapidly for first 2 degrees of travel, then should move slowly, and the control stick should follow the slow movement.

(10) While moving flight controls AFCS emergency disconnect lever — Actuate.

All AFCS switches should disengage, stab-aug off caution light should illuminate, and there should be no noticeable change in force required for control movement.

(11) Stab-aug button — Depress, stab-aug off caution light should go out.

c. ILS Check (when required by mission).

(1) ILS receiver — ON.

Do not use local ILS frequency.

*If parking/starting area is congested these steps may be accomplished in Before Taking Runway check.

- (2) Instrument-selector switch — ILS FINAL.
- (3) Autopilot button — Depress, check that control movement is not excessive.

Control surface movement shall not exceed limits in step b(1) above.

- (4) Altitude and ILS switches — Engage.

When the ILS switch is engaged, the AFCS will lock the control-stick in roll; pitch should remain free. Some minor lateral movement may be apparent at both the control-stick and bank-steering bar on the ADI due to random noise. After a 6- to 21-second delay, the control-stick will move forward, lock in pitch and roll, and the altitude switch should disengage.

Note

Do not repeat engagement for 5 to 10 minutes to allow the thermal time-delay relay to cool, or the 6- to 21-second delay will not be within acceptable limits.

- (5) AFCS emergency disconnect lever — Actuate.

All AFCS switches should disengage and stab-aug off caution light should illuminate.

Check that controls move freely.

- (6) Stab-aug button — Depress, check stab-aug off caution light-out.

d. Autoss check (when required by mission).

- (1) Autopilot button — Depress.

Control surface movement shall not exceed limits in step b(1) above.

- (2) Bomb/Nav switch — BOMB.

There should be no stick motion.

- (3) Weapon-selector knob — SPL WPN.

- (4) Bomb-mode selector — VTIP.

Check that solution light and Hi Toss lights illuminate.

Burst-height pot and target altitude must be set below aircraft altitude in order to obtain solution.

- (5) Altitude switch — Engage.
- (6) Autoss switch — Engage.
- (7) Freeze/fire button — Depress and hold.

The altitude switch should disengage, the control stick should lock up in roll and move aft smoothly.

- (8) As the stick moves aft, AFCS emergency disconnect lever — Actuate.

All AFCS switches should disengage, and the stab-aug off caution light illuminate.

Check that controls move freely.

- (9) Stab-aug button — Depress, check that stab-aug off caution light goes out.

- (10) Bomb/Nav switch — NAV.

- (11) Weapon-selector switch — GUNS-AIR.

- (12) Bomb-mode selector — MANUAL.

20. Pitot heat — Check as required.

- a. Pitot heat switch — ON.

Crew chief check for heat.

- b. Pitot heat switch — OFF.

21. Air refueling probe or receptacle operation — Check (air-refuel flights only). Refer to T.O. 1-1C-1-13.

22. Gun gas purge valve — Check as required [1048] N/C/W.

- a. GUN PURGE C/B out — Check for air.

- b. GUN PURGE C/B in — Check for no air.

23. Stick grip override switch — Check, then NORMAL.

- a. Stick grip override switch — Hold to NOSE DOWN. Stick should move forward.

- b. Stick grip override switch — Hold to NOSE UP. Stick should move aft.

- c. Stick grip override switch — OFF and check that trim switch on control stick is in-operative.

- d. Stick grip override switch — NORMAL.

24. ✕ Trim — Check, then set for takeoff.

Operate the trim-switch to all four positions, and note that control and corresponding surface movements are correct. Leave surfaces out of neutral. The trim-switch should automatically return to the OFF center position when released. Operate the yaw-trim switch to both positions. Trim rudder (yaw trim) to the right, then depress takeoff trim button until light illuminates. Engage nose wheel steering. The aircraft should track true under a no-wind condition.

25. ✕ Flight controls (hydraulic gages) — Check.

Check for correct, full and free travel of flight controls and surfaces. Control movement should be smooth and full cycle of pitch and roll limited to not less than four seconds. Avoid abrupt or rapid control inputs to prevent cavitation of primary hydraulic pumps.

WARNING

When releasing the stick from full left or right position, check that the spoilers return to the neutral position in sequence with the aileron. Failure of the spoilers to sequence with the aileron is an indication of a failing spoiler actuator.

26. Thrust decay/speed brake interlock — Check.

a. Speed brake switch — OUT.

Horizontal speed brakes should open in approximately 4 seconds, but not necessarily synchronized.

b. Throttle — Advance.

As the throttle is advanced to approximately 75 percent RPM a slight drop in RPM indicates the nozzle has closed. After nozzle closes all speed brake doors move in 9 degrees.

c. Throttle — IDLE.

All speed brake doors should move out 9 degrees and nozzle opens.

d. Speed brake switch — IN.

27. Flap lever — LANDING & TAKEOFF.

LE and TE flaps should fully extend, synchronized in approximately 7 seconds.

Check flap-position with flap-position indicator.

28. Fuel tank pressurization — Check.

Advise crew chief to check for external tank pressurization. When he is in position, pressurize the external tanks for 5 seconds and then turn the fuel tank selector to the BB TK (BOMB BAY) position. After waiting approximately 5 seconds in BB TK (BOMB BAY) position, return selector to MAIN TK position. If a 650-gallon centerline tank is carried, start the sequence with the BELLY TK (BELLY) position on the fuel tank selector. Each tank should vent (indicated to the crew chief by a surge of air pressure from the respective tank vent port) as the fuel tank selector is moved to the next position.

29. ✕ Radar — Adjust (*).

30. ✕ Doppler control panel — Set (*).

31. ✕ Fire control system — Check as applicable(*). Refer to T.O. 1F-105B-34-1-1 for fire control preflight checks.

WARNING

On aircraft modified by T.O. 1F-105-992, it is possible to decrease the intensity of the breakaway signal on the gunsight combining glass so that it will not be discernible to the pilot. The breakaway signal should always be presented at maximum intensity so as to eliminate or reduce the possibility of target fixation. To correct this situation, the sight radar and reticle intensity control (992) C/W, item 7, Figure 1-11, T.O. 1F-105B-34-1-1, must be turned full clockwise so that the intensity will provide maximum intensity of the breakaway signal.

32. Sight intensity knob (992) C/W — Full clockwise.

33. Control transfer (take-over) system buttons — Depress all. If dual, order crew member to depress buttons, then depress front cockpit buttons again.

*If parking/starting area is congested these steps may be accomplished in Before Taking Runway check.

The NAV button will not remain depressed if Doppler is off. When crew member has control check front cockpit buttons are illuminated. When front cockpit has control check buttons are not illuminated.

34.  Seat pin — Remove display to crew chief, then stow.

35. Pylon tank safety pins — Insure removal (*).

36.  Canopy — As desired.

37.  ADI — Set.

Align pitch trim knob arrow with fixed index.

38.  AVVI and standby altimeter — Set to field barometric.

The AVVI should indicate within 85 feet of field elevation and the standby altimeter within 50 feet.

39.  Pressure ratio gage — Set for takeoff (*).

See pressure ratio gage setting for takeoff table, figure 2-6.

40.  Utility hydraulic pressure — Check and monitor while taxiing.

41. Brakes — Apply, then signal crew chief to remove chocks.

Parking brakes are not provided.

TAXIING.

Before taxiing, be sure there is proper clearance for the aircraft. See figure 2-4 for minimum turning radius and ground clearance. See figure 2-5 for foreign object damage areas. Taxi at lowest practical RPM to conserve fuel, and to avoid damage from tailpipe blast, especially during multiple taxiing. Observe open canopy speed restrictions in section V.

WARNING

Keep arms clear of canopy rails.

CAUTION

With the antiskid system off, maximum braking at speeds below 60 knots may cause wheel skidding which can result in gear walking and excessive strut loads. If this condition occurs braking effort should be reduced slightly.

Note

If the AFCS check is performed in the BEFORE TAKING RUNWAY check, engage stab-aug so crew chief can observe stabilizer movement in step 1 below.

-  All taxiing shall be accomplished by the pilot in the front cockpit.

1. Brakes — Release and check.

Increase thrust, roll aircraft forward approximately two feet and apply brakes sharply to dip nose. Crew chief will observe stabilizer movement. Maintain directional control through steerable nose wheel by using the rudder pedals.

CAUTION

The aircraft shall not be steered with both brakes and nose wheel steering at the same time as the nose wheel will not caster and excessive side loading will cause damage.

2. Nose wheel steering — Check.

Check engagement by slight movement of rudder pedals. Use nose wheel steering as desired.

CAUTION

Do not hold nose wheel steering button depressed more than 15 minutes. If button is depressed more than 15 minutes, a 30-minute cooling period is required.

3.  Flight instruments — Check.

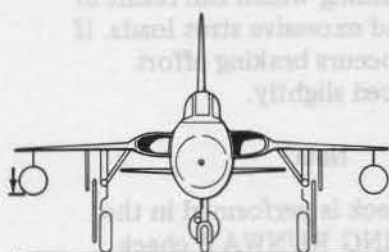
Check flight instruments for proper operation while taxiing. Slip indicator (ball) free in glass tube, and turn needle indicating the direction of turn.

4. Monitor hydraulic pressure gages for low or fluctuating pressures.

* If parking/starting area is congested these steps may be accomplished in Before Taking Runway check.

TURNING RADIUS and ground clearance

MAXIMUM NOSE WHEEL DEFLECTION (40°)



3'-4"

Note

Ground clearance is only 7-½ inches when carrying a centerline MER with 750 pound bombs.

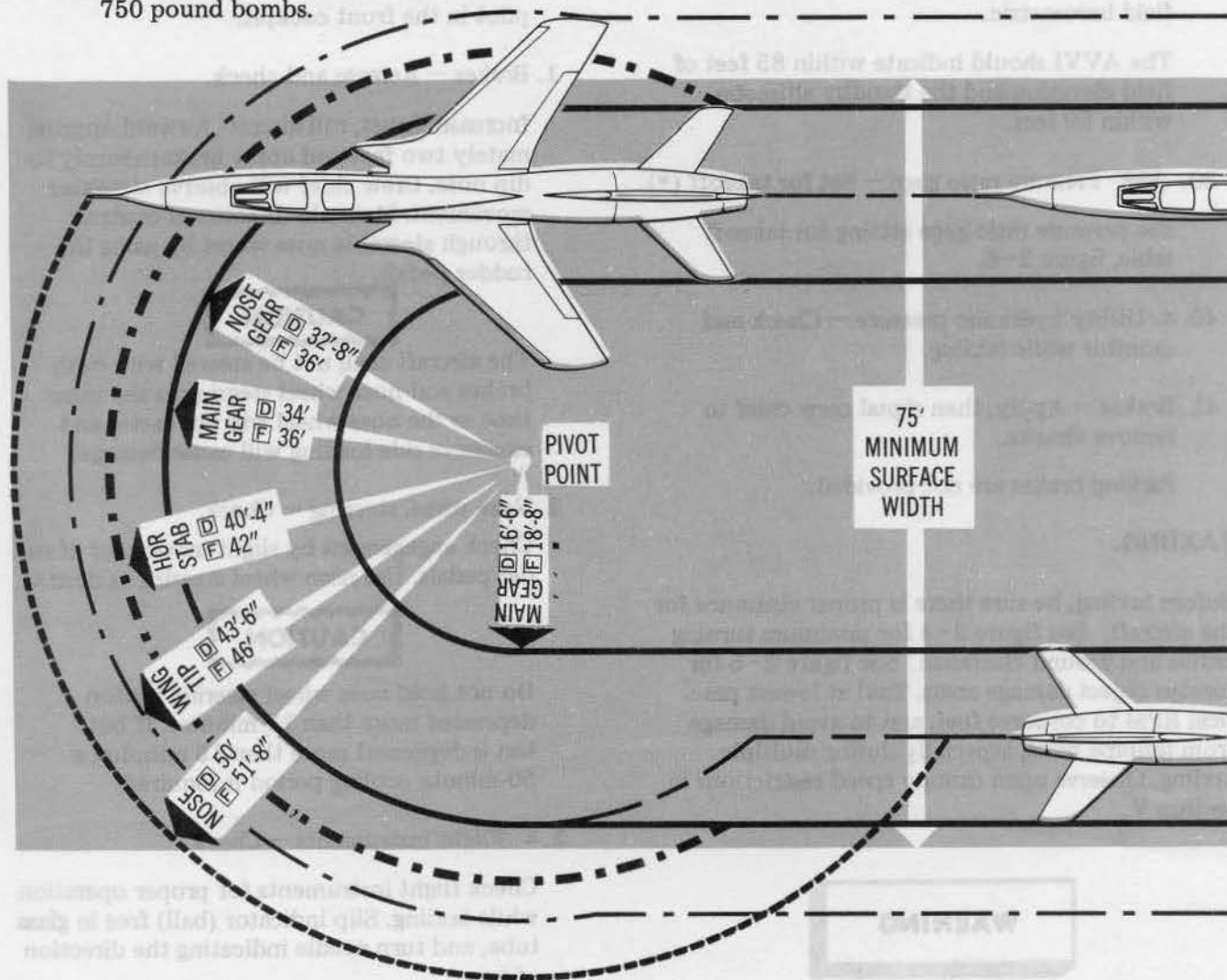
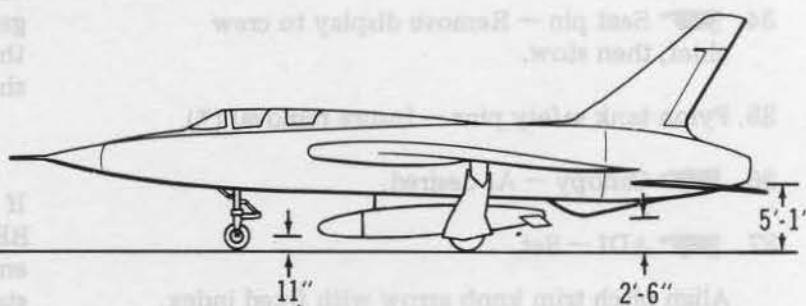


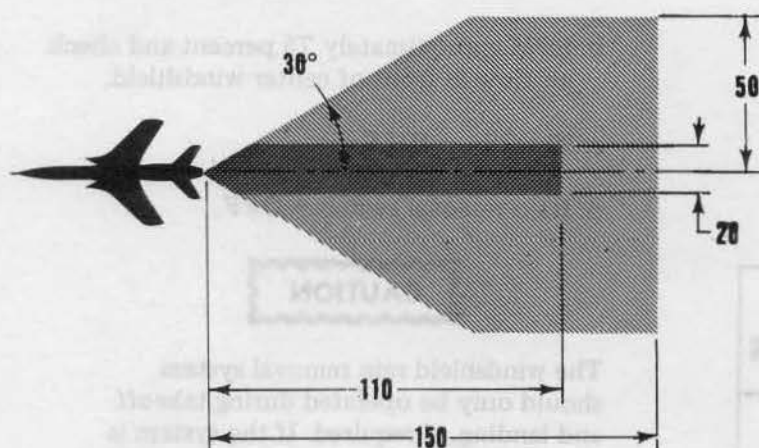
Figure 2-4

FOREIGN OBJECT DAMAGE AREAS

For danger areas during static ground operations, see figure 2-3.

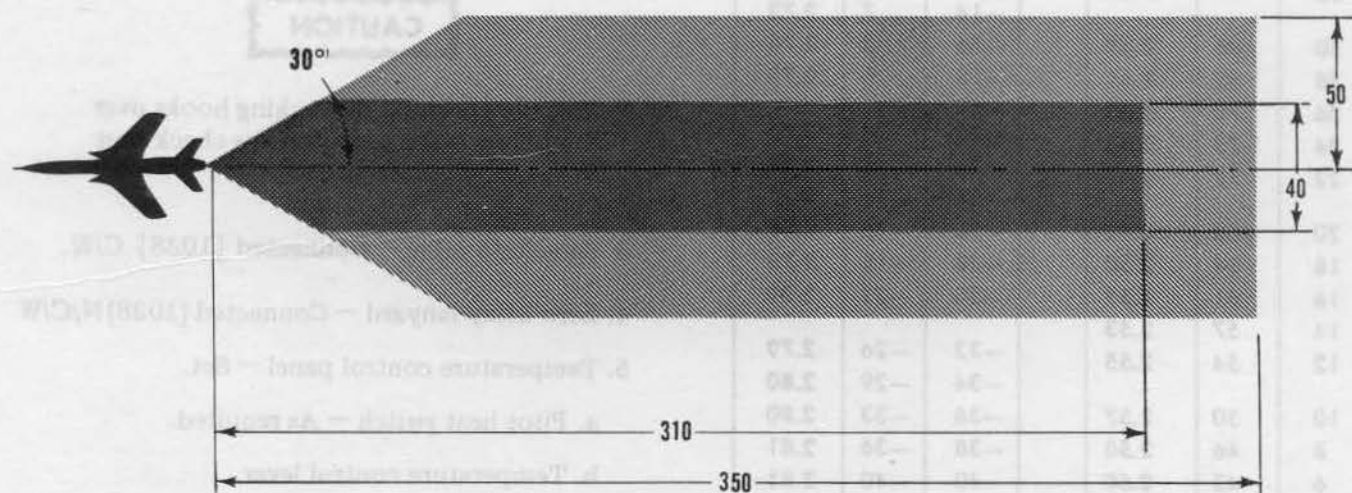
MULTIPLE TAXI

1. Thrust — Idle to 80 per cent RPM
2. Taxi from line — move ahead 150 feet before turning.
3. Keep 150 feet apart (nose to tail) or 50 feet apart laterally.



MULTIPLE TAKEOFF

1. Thrust — Maximum
2. Keep 350 feet apart (nose to tail) or 50 feet apart laterally.



LEGEND

- Possible F. O. D.
- Probable F. O. D.

NOTE: All dimensions are in feet

Figure 2-5

PRESSURE RATIO GAGE SETTING for takeoff

Engine J75-P-19W

Throttle-Military Thrust.

Speed Brake Switch — IN.

RUNWAY TEMPERATURE		GAGE SETTING
°C	°F	
50	122	2.21
48	118	2.23
46	115	2.25
44	111	2.26
42	108	2.28
40	104	2.30
38	100	2.32
36	97	2.34
34	93	2.36
32	90	2.38
30	86	2.39
28	82	2.41
26	79	2.43
24	75	2.45
22	72	2.47
20	68	2.48
18	64	2.50
16	61	2.52
14	57	2.53
12	54	2.55
10	50	2.57
8	46	2.58
6	43	2.60

RUNWAY TEMPERATURE		GAGE SETTING
°C	°F	
4	39	2.61
2	36	2.63
0	32	2.64
— 2	28	2.66
— 4	25	2.67
— 6	21	2.68
— 8	18	2.69
— 10	14	2.71
— 12	10	2.72
— 14	7	2.73
— 16	3	2.74
— 18	0	2.75
— 20	— 4	2.76
— 22	— 8	2.77
— 24	— 11	2.77
— 26	— 15	2.78
— 28	— 18	2.78
— 30	— 22	2.79
— 32	— 26	2.79
— 34	— 29	2.80
— 36	— 33	2.80
— 38	— 36	2.81
— 40	— 40	2.81

Figure 2-6

BEFORE TAKING RUNWAY.

Note

- Ⓔ On dual flights, either cockpit can have control of a system, or systems, but before takeoff the FLIGHT take-over button in the front cockpit shall be engaged and the indicator light out.

1. Windshield rain removal system — Check if required.
 - a. Rain removal switch — ON.
 - b. RPM approximately 75 percent and check air flow in front of center windshield.
 - c. Throttle — IDLE.
 - d. Rain removal switch — OFF.

CAUTION

The windshield rain removal system should only be operated during takeoff and landing, if required. If the system is allowed to remain ON during other periods, excessive heat will crack the windshield.

2.  Canopy — Closed and locked.
 - a. Locking hooks over rollers.
 - b. Caution light out.

CAUTION

Visually checking the locking hooks over the rollers is the only positive check that the canopy is locked.

3. Parachute cable — Connected [1038] C/W.
4. Zero delay lanyard — Connected [1038] N/C/W.
5. Temperature control panel — Set.
 - a. Pitot heat switch — As required.
 - b. Temperature control lever
 - CKPT AUTO ON for dry takeoff.
 - RAM for water injection.

RAM position required to arm water injection control circuit.

c. Forward windshield defog switch — As required.

d. Windshield side panel defroster — As required.

e. ✕ Engine de-ice switch — As required.

f. Rain removal switch — As required.

6. Fuel tank selector switch — Recheck MAIN TK (MAIN).

7. Autopilot — OFF and stab-aug — ENGAGED.

8. ✕ Takeoff trim — Recheck.

9. Flaps — Recheck LANDING & TAKEOFF.

10. Speed brakes — Recheck IN.

11. Seat pin — Recheck, removed.

12. ✕ Doppler present position coordinates — Recheck and reset if necessary.

13. IFF/SIF — As directed.

14. ✕ All caution and warning lights — OUT.

RUNWAY CHECK.

After taxiing into takeoff position complete the following checks.

1. Antiskid — ON.

2. ✕ HSI and magnetic compass — Check against runway heading for operation.

3. Throttle — Advance to Military Thrust.

If condensation, in the form of mist or snow, is blown into the cockpit from the air conditioning outlets, and found to be objectionable to the pilot, select a higher temperature on the cockpit automatic temperature control knob or position the temperature control lever to RAM.

4. ✕ Engine instruments — Check within limits.

Oil pressure, exhaust gas temperature, tachometer, fuel flow, and pressure ratio gages within limits. (Refer to section V.)

5. Flight controls — Check for full and free travel.

TAKEOFF.

WARNING

If takeoff roll is aborted for any reason, subsequent takeoffs shall not be attempted until wheel brakes are inspected. See section V for limitations.

CAUTION

- Ⓕ Design factors of the rear cockpit instrument panel and restricted forward visibility may create an illusionary sensation of extreme aircraft nose high attitude to the crew member in the rear cockpit.

Note

- Ⓕ All takeoffs shall be made by the pilot in the front cockpit.

The following takeoff techniques and procedures (figure 2-7) should produce the results shown in the Appendix I and II, Part 2. Factors affecting a successful takeoff are as follows:

- Know the acceleration check, rotation (nose wheel off) and takeoff speeds for the gross weight at brake release. Refer to the Appendix as these vary considerably with gross weight.
- Do not try to take off if the acceleration check speed is not attained.
- Rotate aircraft at the recommended rotation speed.
- Aft CG configurations will cause the takeoff rotation to be more sensitive and the aircraft will feel as though it is flying off by itself. Smooth pitch control inputs must be utilized during rotation as well as throughout flight.
- Do not try to take off at lower than computed takeoff speed.
- Do not retract landing gear until definitely airborne.

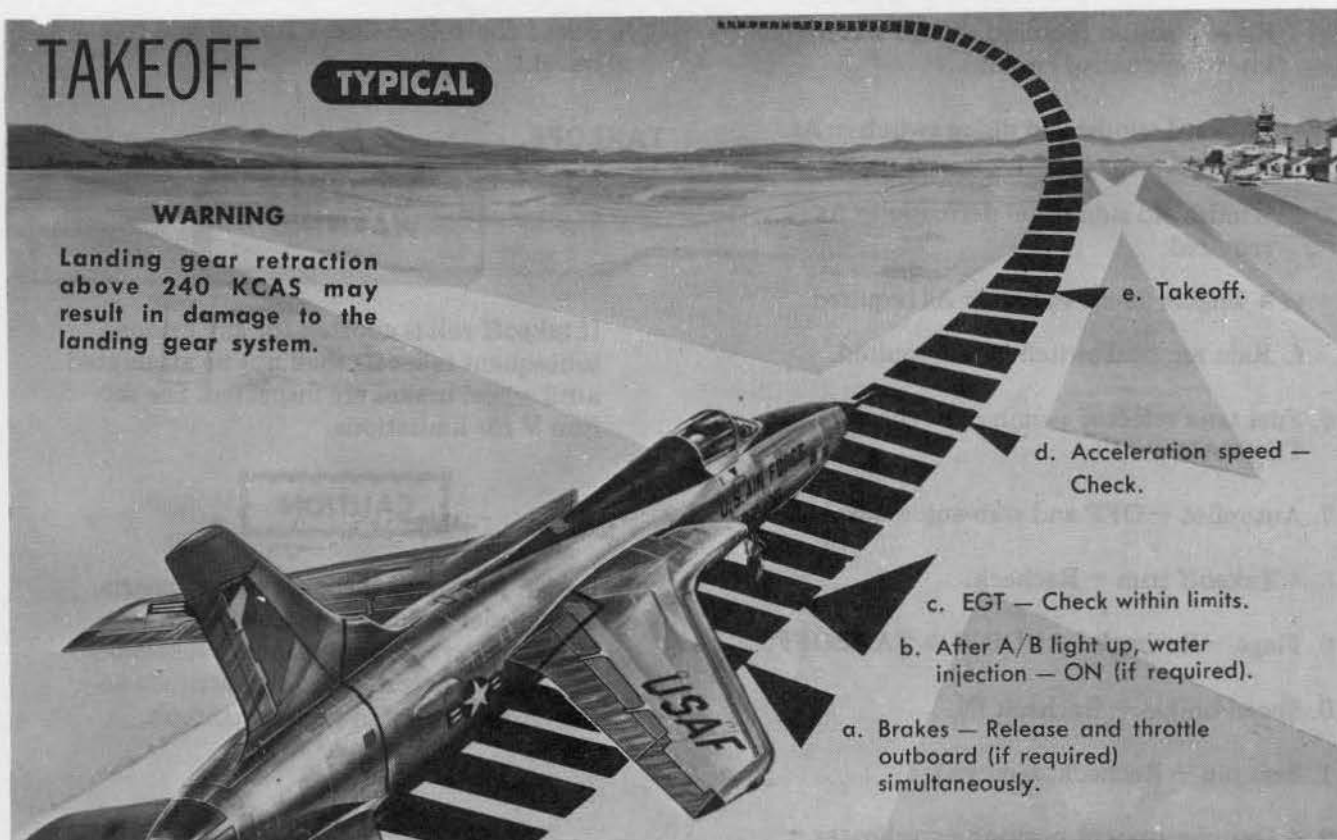


Figure 2-7

- a. Brakes — Release and throttle outboard (if required) simultaneously.

Although A/B may be selected at any throttle position above MIN AFTERBURNER, it is a good practice to select A/B after the engine has attained military thrust to assure a positive light. The A/B should light up within 5 seconds as indicated by a slight decrease in pressure ratio as nozzle opens followed by a sudden increase in pressure ratio to approximately that obtained in Military Thrust accompanied by a sudden “noise-thrust” increase.

WARNING

- When using A/B, verify light up.
 - If nose wheel steering is used, disengage as soon as rudder effective speed is attained. Certain component failures can cause a hard over condition.
- b. After A/B light up, water injection switch — ON (if required).

Illumination of the WATER INJ indicator light indicates water injection is operating. The absence of the water injection light being illuminated does not mean a failure of the water injection system has occurred. The primary indication should be a rise in EPR and EGT.

CAUTION

Water injection should be started after A/B light-up to prevent overspeed of the engine low pressure rotor.

Note

Water injection should not be used if the air temperature is below 4.4°C (40°F), or the altitude is above 8000 feet.

- c. EGT — Check within limits.

EGT must remain within applicable limits, see section V.

d. Acceleration Speed — Check.

Cross check the standby airspeed indicator with airspeed tape at the acceleration speed check point and also just prior to rotation. If the spread between these two units exceeds 25 knots at the acceleration speed check point or exceeds 20 knots just prior to rotation, perform ABORT procedures if sufficient runway length is available; if not, continue takeoff using the standby airspeed indicator. Land as soon as practical, using the standby airspeed indicator.

e. Takeoff.

- Takeoff at no lower than precomputed takeoff speed.
- Anticipate the acceleration of the aircraft and rotate the nose smoothly so that the nose wheel lift-off occurs at nose wheel lift-off speed.
- Continue rotation smoothly until proper take-off attitude (approximately 10 degrees nose up) is reached simultaneously with the precomputed takeoff speed. The amount of rotation will be indicated on the ADI. The attitude will be such that the ventral fin will not scrape and the excess thrust will be more than enough to ensure positive climb and acceleration.

WARNING

- Premature rotation of the aircraft will result in increased takeoff distance or premature lift-off with subsequent settling back on the runway.
- If during takeoff any part of the aircraft strikes the runway with gear retracted and it is impossible to obtain takeoff attitude and speed — ABORT.
- If stab-aug disengages during takeoff, do not reengage until controls are trimmed, attitude is stabilized and altitude is such that a recovery could be made if a malfunction occurs.

CROSSWIND TAKEOFF.

Crosswind takeoff characteristics are similar to all other century series aircraft. Nose wheel steering can be used up to rudder effective speed of 60 KCAS. The aircraft will track well with the rudder

being the most effective directional control at the higher speeds. Lateral control application is ineffective for crosswind configuration at low speeds (below 100 KCAS); however, slight application into the wind may be beneficial near the takeoff speed to avoid downwind drift. For heavy, gusty crosswinds it is recommended that the rotation and takeoff speeds be increased approximately 5 knots. Refer to Takeoff Crosswind Chart in Appendix I and II, Part 2.

CAUTION

The spoilers create asymmetric drag and excessive application during the takeoff ground roll can aggravate directional control. Extreme care should be used as drag will be in the direction of spoiler application.

AFTER TAKEOFF — CLIMB.

1. ✕ When definitely airborne, landing gear handle — UP.

When definitely airborne and after adequate flying speed is reached and positive rate of climb is established retract gear. The landing gear warning signal (beeper) will sound and the warning light in the landing gear handle should illuminate during retraction until the gear is up and locked. Obtain up and locked gear prior to exceeding 240 KCAS as the gear may not retract at higher speeds.

WARNING

When the landing gear is retracting, the normal tendency of the clean aircraft is to pitch down.

CAUTION

- Landing gear retraction above 240 KCAS may result in damage to the landing gear system.
- Maximum speed with landing gear extended is 275 KCAS.
- Failure of the warning signal (beeper) to sound or the warning light to illuminate during retraction is an indication of a failure in the warning system and must be considered as an unsafe gear.

- F When retracting gear, move gear handle firmly to its full UP position and then exert a

downward pressure to assure the rear cockpit gear handle is also latched in the UP position.

- Unusual takeoff conditions (high gross weight, temperature, density, altitude, or various combinations of these factors) must be considered if landing gear fails to retract. The 240 KCAS gear up limiting airspeed borders on minimum safe speed to maintain level flight on military power under these conditions. Maximum thrust must be maintained during recycling until further acceleration is possible. Airspeed should be limited to below 240 KCAS with speed brakes and/or steeper than normal climb until gear is retracted, however, primary concern should be to positive aircraft control.

Note

If it is necessary to re-cycle the landing gear for any reason, a recheck of the gear retraction and warning system can be accomplished as follows: After gear is retracted and landing gear position indicator lights are out, depress the landing gear warning test button. Illumination of the landing gear handle light, gear position indicators and sounding of the beeper will indicate that the warning system is functioning properly.

- If the landing gear handle is stuck in the DOWN position, the landing gear down-lock override switch should be depressed and held while the handle is moved out of the DOWN position.
2. ✕ Flap lever — CRUISE & MANEUVER (240 KCAS min). Flap indicator — Check flaps UP. If flaps fail to retract place flap lever in HOLD TE FLAPS and maintain airspeed below 275 KCAS.

WARNING

Flap auto blow-up feature will be inoperative if flaps stop because of an out of phase condition (activation of the fail safe switch) [1045 and 1049] N/C/W.

Note

To insure that the leading edge flaps are at the correct position for cruise place the flap handle in the LE & TE FLAPS UP position then return it to the CRUISE & MANEUVER position.

3. Water injection switch — Dump, after 5 minutes — OFF.

WARNING

The water tank must be drained after take-off as the water tank is not stressed for high G loads when full, and an aft CG condition may result.

4. A/B — OFF (as required).
5. Temperature control level — CKPT AUTO ON (as required).

Water will automatically dump when temperature control lever is taken out of RAM position as airspeeds above 275 KCAS.

6. Rain removal switch — OFF (if used).
7. ✕ Fuel tank selector switch — As required.

Refer to section V for fuel system limitations and section VII for fuel system management with external stores.

8. ✕ Zero delay lanyard — DISCONNECT prior to reaching climb-out airspeed (400 KCAS) or 2000 feet AGL [1038] N/C/W.

The zero delay lanyard should be disconnected above 400 KCAS and/or 2000 feet to reduce the opening shock in the event of ejection. The short delay in the automatic EGRESS System will allow time for the forward motion of the pilot to be reduced, reducing the opening shock.

9. ✕ Oxygen — As desired.

10. ✕ Reset AVVI and standby altimeter barometric when climbing as required.

CLIMB.

The following climb technique will produce results outlined in the Appendix. For a maximum thrust or military thrust climb, Mach number is held constant. If a maximum continuous thrust climb is desired, the throttle is adjusted to approximately 3 percent less than full Military RPM. Once the desired thrust condition is set, the fuel control will maintain an approximate constant percent thrust output with a fixed throttle position. Engine pressure ratio, which varies with compressor inlet temperature, will increase as the temperature becomes lower at the higher altitudes.

CRUISE.**Note**

Cruise climb is the method of achieving maximum long-range cruise performance by continually increasing cruise altitude as gross weight decreases.

Cruise control data for various gross weights and configurations are included in the Appendix. Individual fuel quantity gages should be checked frequently during cruise to determine proper fuel distribution. This will indicate if the forward, aft and main fuel tank boost pumps are operating and transferring fuel in the proper sequence even though the fuel low caution and boost pump caution lights are inoperative. Refer to section VII for fuel system management and engine characteristics during cruising. The windshield side panel defrosting system should be operated at the highest possible temperature (consistent with the pilot's comfort) during high altitude flight, to provide sufficient preheating of the transparent surfaces to preclude the formation of frost or fog during descent.

Note

The forward and aft boost pump caution lights may flash on and off due to sloshing of trapped fuel in the tanks.

- [E] The pilot intending to take control of a subsystem should first ask the pilot having control what the positions of the controls governing the particular subsystem are and set his equivalent controls accordingly before actuating the control transfer (take-over) button.

SUPERSONIC FLIGHT.

1. VAI switch — AUTO.
2. ✕ Flap lever — LE & TE FLAPS UP.

FLIGHT CHARACTERISTICS.

Refer to section VI.

DECELERATION PROCEDURE.

The throttle should not be retarded from the full forward position while the aircraft speed is above Mach 1.3. Deceleration is accomplished as follows:

1. ✕ Throttle — As required when speed is below Mach 1.3.
2. VAI switch — CRUISE when speed reduces to subsonic.
Check duct plugs full aft.
3. ✕ Flap lever — CRUISE & MANEUVER.

DESCENT.

Refer to the Appendix I, Part 7 for recommended descent speeds, time required, fuel consumed, and distance covered during descent. Descent can be made as rapidly as necessary, provided pullout is accomplished at a safe altitude. Refer to section VI for altitude lost during dive recovery. Prior to descent accomplish the following:

1. Forward windshield defogging switch — As required.
2. Windshield side panel defroster — As required.
3.  Reset AVVI and standby altimeter barometric as required.
4.  Zero delay lanyard — Attach prior to high fix or at 2000 feet AGL during enroute descent [1038] N/C/W.

BEFORE LANDING.

- [E] 1. FLIGHT transfer button in front cockpit — Engaged and light out. (Remaining transfer buttons optional.)
All landings shall be made by pilot in front cockpit.

2.  Autopilot button — Check OFF.
3. ✕ FUEL QUANTITY — CHECK (monitor total internal position).
4. ✕ Flap Lever — HOLD TE FLAPS.
5.  Zero delay lanyard — Check attached [1038] N/C/W.
6.  Oxygen diluter lever — 100% OXYGEN.
7. ✕ Hydraulic pressure gages (3) — Check normal.
8. Rain removal switch — As required below 270 KCAS.

CAUTION

The windshield rain removal system should be operated below 270 KCAS during takeoff and landing, if required. If the system is allowed to remain ON during other periods, excessive heat will crack the windshield.

LANDING PATTERN.

Maintain as high a throttle setting as is consistent with approach conditions before landing. Although the engine will respond normally when accelerated from idle, it is preferable to maintain a minimum of 75 to 80 percent RPM during the approach to minimize the time delay required to obtain sufficient thrust if a go-around becomes necessary. For a normal landing fly the pattern shown in figure 2-8. Refer to the Appendix for exact final approach and touchdown speeds for a given landing gross weight. For landing CG and gross weight limitations refer to section V.

1. ✕ Landing gear handle — DOWN below 275 KCAS.

CAUTION

It is possible to achieve a gear down and locked condition without having the gear handle in the full down position. This condition will not allow the handle locking solenoid to lock the handle down and could result in inadvertent actuation on the ground.

After receiving a down and locked indication, the pilot (front cockpit in  should press the gear handle down to assure it is in the full down position.

2. ✕ Flap lever — LANDING & TAKEOFF.

LANDING.

NORMAL LANDING.

Note

-  All landings shall be made by the pilot in the front cockpit.

The key to a good landing is precise airspeed control. The use of the angle of attack indicator on final approach is covered in figure 2-8. After establishing final approach speed, begin flare to touchdown at intended point and at recommended speed for aircraft gross weight. To gain the benefit of aerodynamic drag, the speed brakes may be extended prior to landing. To preclude excessive rates of sink during flare, a 2.5- to 3.0-degree final approach is recommended. Rate of sink should be controlled by power until touchdown. Touchdown at recommended speed and simultaneously reduce throttle to idle. Increase back pressure to hold nose off. To gain maximum drag chute effectiveness, which is obtained in the higher allowable speed regions, the drag chute should be deployed as soon as positive directional control is available.

CAUTION

If the drag chute fails to deploy and a go-around is initiated, the drag chute handle should be rotated and pulled aft to the jettison position to prevent unexpected deployment.

Maximum aerodynamic braking is obtained by holding the nose off. The aircraft nose should be gently lowered to the runway at  130 KCAS;  140 KCAS. The rudder is effective for maintaining directional control down to approximately 60 KCAS. Additional directional control may be obtained by use of brakes. If necessary, nose wheel steering may be engaged after the nose wheel is on the runway and the rudder pedals are in neutral. Oversensitivity must be anticipated at speeds above 80 KCAS.

CAUTION

Do not engage nose wheel steering until the nose wheel is on the ground. The switches actuating the system are on the main gear struts and it is possible to engage nose wheel steering before the nose wheel is on the ground. Such engagement could result in an abrupt change in direction when the nose wheel contacts the runway.

There is no difficulty in slowing the aircraft if touchdown is made at recommended speeds. The landing distances in the Appendix are computed with speed brakes extended and a single smooth application of the brakes with constantly increasing pedal pressure. Wheel brake operation is covered in section I.

CAUTION

If an unknown type of brake malfunction occurs, pull emergency brake handle. The antiskid system will become inoperative.

- If an antiskid malfunction occurs during landing, the brakes should be released and the antiskid switch positioned to OFF immediately.

HEAVYWEIGHT LANDING.

Heavyweight landing procedure is the same as for normal landing except for increased approach and touchdown speeds as presented in the Appendix. Recommended approach speeds and glide angles must be adhered to and landings must be smooth with very low sink rates; refer to section V.

CROSSWIND LANDING.

Crosswind landing procedure is the same as for normal landing except that the following steps should also be accomplished: Hold upwind wing down through touchdown to maintain a non-crabbing approach. For extremely high crosswinds, a combination crab-wing low approach should be maintained through touchdown. To minimize weather vaning and to improve directional control, avoid excessive nose high attitude and lower nose immediately after touchdown. Final approach and touchdown speeds should be increased 5 knots for every 10 knots of crosswind component to compensate for loss of lift from the spoilers. For

crosswind landing speeds for specific gross weights, refer to the Landing Crosswind Chart in Appendix I and II, Part 8.

CAUTION

Spoilers create asymmetric drag and excessive application during the approach and landing roll can adversely affect directional control. Extreme care should be used as drag will be in the direction of application.

Note

Be prepared for weather vaning in crosswind landings when drag chute is deployed. If excessive weather vaning is encountered, jettison drag chute to obtain better directional control.

LANDING IN GUSTS.

Landing in gusts procedure is the same as for normal landing except, add one half of gust factor to final approach and touchdown speeds. The gust factor is the difference between the steady wind and gust wind speeds. If the steady wind is 20 knots with gusts to 30 knots the gust factor would be 10 knots; add 5 knots to the final approach and touchdown speeds for gust factor.

MINIMUM RUNWAY LANDING.

Minimum runway landing procedure is the same as for a normal landing except to achieve optimum Short Field Landing capability on a dry runway, immediately after touchdown, lower nose wheel to runway and apply moderate to heavy wheel braking. As speed decreases, increase to heavy braking. Pulling the stick back at lower runway speeds (below approximately 130 KCAS) will provide additional drag. Refer to section VI for additional discussion.

LANDING ON WET/ICY (SLIPPERY) RUNWAY.

Wet/icy runway landing procedure is the same as for normal landing except, hold the nose off longer to derive maximum aerodynamic braking. Use rudder for directional control, and use extreme caution when brakes are applied. If a side skid develops, release brakes immediately until the aircraft straightens. Use crosswind landing procedure if a crosswind exists. Refer to minimum runway landing, section VI, for additional discussion on braking.

LANDING PATTERN

TYPICAL

- AIRSPEEDS GIVEN ARE BASED ON LANDING GROSS WEIGHT OF: ☐ 31,500 LB, ☐ 33,500 LB.
(Aircraft with B/B tank, two 450 gal tank and 2000 pounds of fuel).
- ADD 3 KNOTS TO THE SPEEDS FOR EACH 1000 POUNDS OF ADDITIONAL WEIGHT.
- AIRSPEEDS FOR OTHER GROSS WEIGHTS WILL BE FOUND IN THE APPENDIX.

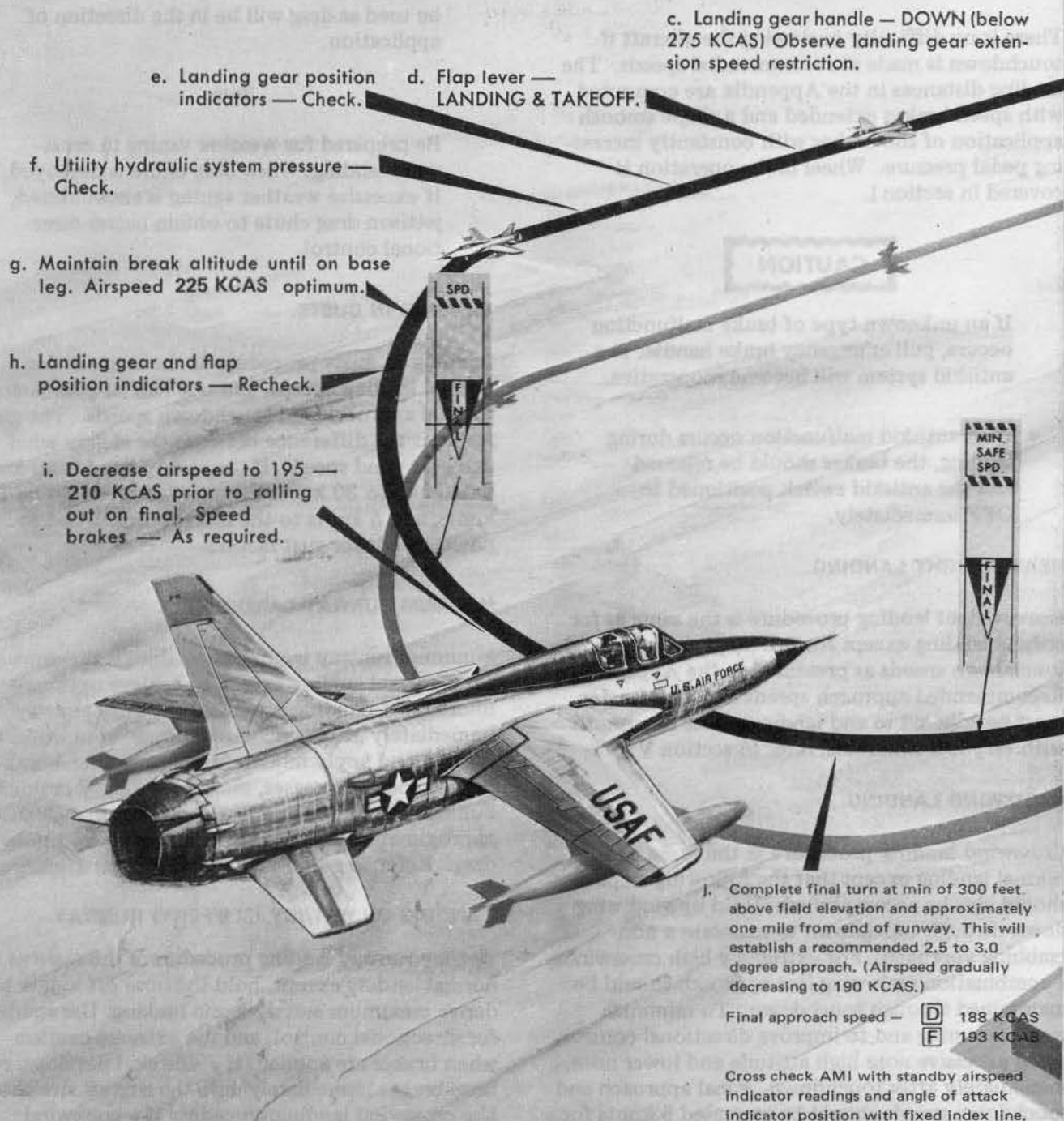


Figure 2-8 (Sheet 1 of 2)

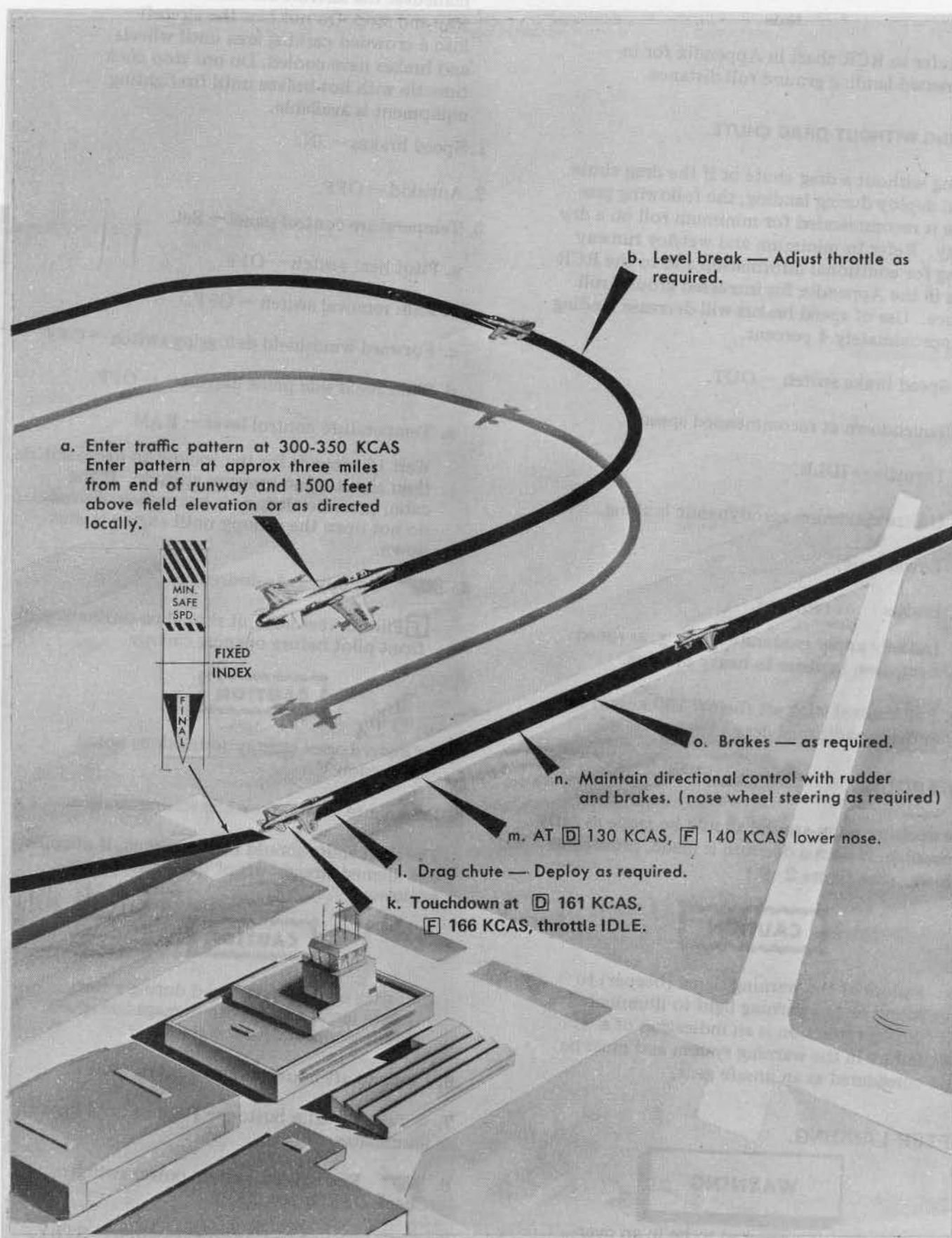


Figure 2-8 (Sheet 2 of 2)

Note

Refer to RCR chart in Appendix for increased landing ground roll distance.

LANDING WITHOUT DRAG CHUTE.

Landing without a drag chute or if the drag chute fails to deploy during landing, the following procedure is recommended for minimum roll on a dry runway. Refer to minimum and wet/icy runway landing for additional information and to the RCR charts in the Appendix for increased ground roll distance. Use of speed brakes will decrease landing roll approximately 4 percent.

- a. Speed brake switch — OUT.
- b. Touchdown at recommended speed.
- c. Throttle — IDLE.
- d. Utilize maximum aerodynamic braking.
- e. Lower nose.
- f. Brakes — As required.

Initially apply moderate braking; as speed decreases, increase to heavy braking.

- g. Pull control stick aft (below 130 knots) to provide additional drag.

GO-AROUND.

The decision to go-around should be made as early as possible. If such a decision is made, proceed as follows. (See figure 2-9.)

CAUTION

Failure of the warning signal (beeper) to sound or the warning light to illuminate during retraction is an indication of a failure in the warning system and must be considered as an unsafe gear.

AFTER LANDING.

WARNING

If brakes are suspected to be in an over-heated condition after excessive use,

maneuver the aircraft off the active runway and stop. Do not tow the aircraft into a crowded parking area until wheels and brakes have cooled. Do not stop cockpit throttle with hot brakes until firefighting equipment is available.

1. Speed brakes — IN.
2. Antiskid — OFF.
3. Temperature control panel — Set.
 - a. Pitot heat switch — OFF.
 - b. Rain removal switch — OFF.
 - c. Forward windshield defogging switch — OFF.
 - d. Windshield side panel defroster — OFF.
 - e. Temperature control lever — RAM.

Wait 15 seconds for the cockpit to depressurize, then check cabin pressure altitude. If the cabin pressure altitude is below field altitude do not open the canopy until engine is shut down.

4.  Canopy — As desired.

[F] Pilot in rear cockpit should co-ordinate with front pilot before opening canopy.

CAUTION

Observe open canopy restrictions noted in section V.

5. Drag chute — jettison while rolling straight.

The drag chute should be blossomed, if possible, and aligned straight aft of the aircraft when jettisoned.

CAUTION

If drag chute is jettisoned during a turn, heavy metal fittings can damage the speed brake doors and/or the stabilizer.

6. Fwd and aft boost pump switches — OFF.
7.  Take off trim button — Depress until light illuminates.
8.  Fire control system power switch — Check OFF; if not OFF:
 - a. Fire control system power switch — STBY.

GO-AROUND

TYPICAL

- 
- Throttle — Military Thrust (A/B if required).
 - Speed brake switch — In.
 - Drag Chute — Jettison (if deployed or failed to deploy).
 - When definitely airborne, landing gear handle — UP. Obtain up and locked gear prior to exceeding 240 KCAS.
 - Flap lever — CRUISE & MANEUVER (240 KCAS MIN). Flap indicator — Check flaps UP. If flaps fail to retract, place flap handle to HOLD TE FLAPS and maintain airspeed below 275 KCAS.

WARNING

If afterburner lights up when pitch trim change occurs, due to landing gear retraction, pilot-induced pitch oscillations may occur.

CAUTION

If A/B is required, thrust will be less than full Military Thrust until A/B lights, which may take up to five seconds.

- In the event of lack of thrust or acceleration during a go-around, failure of the thrust decay switch can be suspected and the go-around should be completed with use of A/B. A go-around may be accomplished if a failure of the VAI system is such that it is impossible to return the duct plugs to their normal full aft position.

F When retracting gear, move gear handle firmly to its full UP position and then exert downward pressure to assure the rear cockpit gear handle is also latched in the UP position.

NOTE

Fuel consumed during a go-around will be approximately 250 pounds without afterburner and 1000 pounds with 40 seconds afterburner operation.

On normal go-around, military thrust will provide sufficient thrust. However, if the weight and/or external load configuration warrants, afterburner may be used.

Figure 2-9

- b. Radar mode SRCH/ATK button — Depress.
 - c. Check antenna stowed.
 - d. Fire control system power switch — OFF.
9. ✕ Flap lever — LE & TE FLAPS UP.
10. ✕ AFCS emergency disconnect lever — Depress.
- Check for negligible control surface motion and stab-aug disengagement. Minor surface transients may result when the series actuators center lock.
11. Navigation equipment — OFF.
- a. IFF/SIF — OFF.
 - b. Doppler — OFF.
 - c. ILS — OFF.
 - d.  TACAN — OFF.
12. ✕ Utility hydraulic pressure — Monitor.

ENGINE SHUTDOWN.

- 1. Throttle — IDLE.
- 2. Wheels — Chocked.

Receive signal from ground crew that wheels are chocked before releasing brakes.

- 3. Antiskid — Check, then OFF.

Apply moderate-to-heavy brake pressure on one brake pedal. Check for pedal pulse when turning antiskid on to indicate energized antiskid system. Turn off antiskid and duplicate check for other brake.

Note

If pedal pulse is not felt, have crew chief check for pulse in brake line or brake discs on landing gear.

If pedal pulse is not felt, have crew chief check that antiskid fail-safe system is reset.

- 4. Radio — OFF.
- 5.  Canopy — OPEN.

- 6. Idle stop — Disengage.

If idle stop is engaged (up) it will require approximately 30 pounds of force be applied and held for the pilot to move the throttle to OFF.

- 7. Throttle — 75 percent RPM.

Operate engine at approximately 75 percent RPM for a minimum of 15 seconds and a maximum of 30 seconds immediately before shutdown to properly scavenge engine oil.

CAUTION

To prevent damage to equipment, the Doppler heading reference switch and the fire control system power switch must be OFF before the ATM is stopped.

Note

Delay at IDLE momentarily to allow nozzle to open.

- 8. Throttle — OFF.
- 9. Engine deceleration — Check.

Check that engine decelerates freely.

- 10. ✕ DC generator caution light — Check that light illuminates when RPM drops below approximately 30 percent.

If engaged, the RADAR and TACAN takeover buttons should pop up. If the DC generator light does not illuminate position DC generator switch to OFF. This will avoid damage to the battery caused by a malfunctioning reverse current relay.

- 11. ✕ Fuel tank selector switch — OFF at 0 percent RPM [997C and 1044] N/C/W.

Do not turn fuel tank selector OFF while the engine is rotating due to possibility of collapsing fuel lines.

- 12. Fuel shutoff switch — SHUTOFF at 0 percent RPM [997C or 1044] C/W.

Do not position the fuel shutoff switch to SHUTOFF while the engine is rotating due to possibility of collapsing fuel lines.

13. AC generator switch — OFF.

14. Inverter switch — OFF.

15. Battery switch — OFF.

 If engaged, the FLIGHT, NAV, COMM and WEAPONS takeover buttons should pop up.

16.  Oxygen system — Normal.

BEFORE LEAVING THE AIRCRAFT.

1.  Seat safety pin — Installed in seat leg brace before releasing safety belt.

CAUTION

Do not lay shoulder harness straps over the head rest or between head rest and seat. If the canopy is actuated with the shoulder harness in this area, damage to the shoulder harness and canopy actuator/remover can result.

2. Parachute firing cable — Disconnect from the parachute deployment gun actuator and install safety pin and dust cap in the cable [1038] C/W.

WARNING

The force-deployed parachute contains a ballistically fired deployment gun. Extreme caution shall be exercised any time parachute is handled. Ensure that safety pin, streamer, and dust cap are always engaged in cable assembly to prevent deployment gun being discharged when cable assembly is not connected to actuator on ejection seat. Hold parachute so that barrel of deployment gun points away from all personnel and towards a suitable parapet in case of discharge.

CAUTION

Do not apply pressure to spring-loaded dust cover on actuator when removing parachute cable or deformation of the cover may result.

Note

A force of 35 to 50 pounds is required to separate the parachute firing cable end fitting from the actuator.

3. AFTO Form 781 — Insure completed.

CAUTION

In addition to established requirements for reporting any system defects, unusual and excessive operations, entries will be made on the AFTO Form 781 to indicate when any limits noted in the Flight Manual have been exceeded.

COCKING PROCEDURE.

QUICK STRIKE COCKPIT.

Complete the COCKPIT CHECK then do the following:

1. ✕ Fuel tank selector switch — OFF [997C and 1044] N/C/W.
2. ✕ Fuel shutoff switch — SHUTOFF [997C or 1044] C/W.
3. Battery switch — OFF.
4. ✕ Fuel tank selector switch — MAIN TK (MAIN).
5. Fuel shutoff switch — ENGINE FEED [997C or 1044] C/W.
6. Boost pump switches — ON.
7.  Radio — Set and ON.
8. R-14A Radar — Set.
9. ✕ Flap lever — LANDING & TAKEOFF.
10. Speed brake switch — IN.
11. Oxygen diluter lever — 100%.
12. Fire control system power switch — STBY.
13. Inverter switch — STANDBY.
14. IFF/SIF — Set and STDBY.

15. TACAN — Set and T/R.
16. ILS — Set.
17. Cockpit lights — Set and ON.
18. Navigation light — ON (if required).

SCRAMBLE START.

1. Battery switch — ON.
2. Cartridge start button — Depress until positive indication of RPM.
3. Throttle — IDLE when tach indicates 8 percent RPM.
4. ATM switch — START AT 50% RPM.
5. AC generator switch — RESET then ON.
6. ✕ Doppler — ON.

7. Fire control system power switch — ON.
8. Stab-aug — ON.
9. ✕ Trim for takeoff.
10. Safety pins — Removed.
11. Canopy — Closed and locked.
12. Chocks — Remove.

ON RUNWAY.

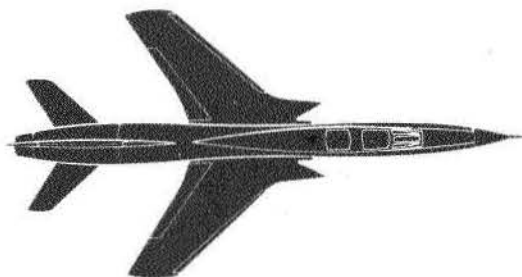
1. Antiskid — ON.
2. Pitot heat switch — Set.

ABBREVIATED CHECKLIST.

Your Normal Procedure abbreviated checklist is contained in T.O. 1F-105D-1CL-1.

Section III

EMERGENCY PROCEDURES



NOTE

These emergency procedures are in the phase of operation sequence as outlined in the table of contents. This permits the presentation of failures in the order in which they can be anticipated, or where they will have a more serious effect on aircraft operation. Certain failures are presented under the indication or symptom of the failure to assist you in recognizing the failure and accomplishing the appropriate procedure. Decision factors are also provided as a guide in the selection of certain procedures.

- ⓔ Emergency Procedures will be initiated by the pilot presently flying the aircraft (front or rear cockpit). The pilot in command is in the front cockpit and will take over control as soon as it is safe to do so.
- ⓔ Procedural steps preceded by a  will also be accomplished by the crew member in the rear cockpit.

NOTE

All odors not identifiable by the flight crew shall be considered toxic. Immediately go on 100 percent oxygen, properly ventilate the aircraft and land as soon as practicable. Do not take off when unidentified odors are detected.

DEFINITIONS

CRITICAL PROCEDURE — A critical procedure is an emergency that must be performed immediately without reference to printed checklists and which must be committed to memory. These procedures are presented in Capitalized **BOLD** face type.

JETTISON AS REQUIRED — If in the judgment of the pilot, aircraft handling characteristics are marginal or compromised due to external stores, tanks and external stores should be jettisoned. Normally, empty 450-gallon wing tanks do not adversely affect aircraft handling characteristics and may be retained.

LAND AS SOON AS POSSIBLE — Declare an emergency and land the aircraft without delay. Aircraft gross weight should be reduced by jettisoning external stores. A landing should then be accomplished at the nearest suitable airfield.

LAND AS SOON AS PRACTICAL — Aircraft gross weight may be reduced by burning out fuel. A landing can then be accomplished as soon as maximum emergency landing gross weight is reached or at any time thereafter.

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GROUND OPERATIONS.

This phase of operation is from starting the engine thru taxiing to takeoff position and includes runway emergencies resulting from aborted takeoff, or that occur on landing roll.

STARTING ENGINE.

ENGINE FIRE DURING START.

If the fire or overheat warning light illuminates, or there is evidence of fire, proceed as follows:

1. THROTTLE — OFF.
2. Fuel tank selector — OFF [997C and 1044] N/C/W.
3. Fuel shutoff switch — SHUTOFF [997C or 1044] C/W.
4. Fire Extinguishing Manual Discharge Switch — Depress.
5. Battery switch or DC external power — OFF.
6. *On pneumatic start* — Signal crew chief to shut off air.
7.  Evacuate the aircraft.

TAXIING.

Brake Failure (or ATM/Utility Hydraulic Failure).

1. Emergency brake — Pull.

Only three full brake applications are available. Each reduction in brake pressure bleeds off the total amount of hydraulic fluid available.

RUNWAY EMERGENCY PROCEDURES.

On most takeoff emergencies the pilot is faced with the decision between aborting or continuing the takeoff. The major failures involving such a decision are:

- Complete or partial loss of thrust (engine failure, A/B failure, engine fuel pump element failure, fuel control failure, etc.).
- Fire or overheat indication.
- Tire failure.

The decision will be influenced by the nature of the failure, the speed and point of takeoff roll where the emergency is recognized and the ability to accomplish a safe abort, or continue takeoff to safe altitude for subsequent emergency procedures.

WARNING

If during takeoff any part of the aircraft strikes the runway with gear retracted and it is impossible to obtain takeoff attitude and speed — ABORT.

ABORT/BARRIER ENGAGEMENT.

ABORT/BARRIER ENGAGEMENT/DECISION FACTORS.

In making the decision to abort certain known fixed factors about the runway, barrier and aircraft configuration must be considered:

Runway.

- Length.
- Condition of surface.
- Condition or type of over-run area.

Barrier.

- Location.
- Type.
- Capability.

Aircraft Configuration.

- Gross weight.
- External stores.

Nature of Abort.

- Early decision to abort — Low speed, maximum runway available for braking.

- Late decision to abort — High speed, minimum runway available for braking.
- Availability of drag chute.
- Type of failure and degree of control of aircraft. (Utility hydraulic system available for normal brakes, antiskid system and nose wheel steering.)

The decision to retain or jettison external stores on the runway prior to a barrier engagement must be made by the pilot. Certain stores may be jettisoned to reduce gross weight to within the barrier or arresting hook/barrier engagement limits, or establish a configuration that will improve barrier engagement probability. However, jettisoning fuel tanks can result in their colliding with the aircraft, or following the aircraft into the barrier resulting in possible fire.

- If gross weight and/or speed is excessive, certain stores may be jettisoned. Refer to figure 3-1 for arresting hook/barrier limitations.
- With two 450 gallon inboard tanks installed, engagement characteristics are comparable to the clean aircraft.
- MA-1/1A web barrier engagement with a 650-gallon centerline tank, centerline MER or MN-1A dispenser installed is unlikely.

WARNING

A jettisoned centerline store will be boxed in by the landing gears and ventral fin, and will probably hit one or more sides of the box before escaping. Damage to the tail hook assembly is possible preventing its use during barrier engagement.

- Refer to applicable Weapon Delivery Manual for instructions on permissible jettisoning of special stores.

CANOPY RETENTION/FACTORS.

Takeoff and landing emergencies ending with the aircraft inverted, or inability to open the canopy electrically, manually or by jettisoning are remote. Aircrew survival is enhanced by retaining the canopy during crash type emergencies. The canopy may

prevent cables or wires from coming into the cockpit in addition to offering temporary protection against being saturated with flaming fuel and the direct effects of fire. Therefore, the canopy should be retained until exit from the cockpit is possible.

- Manual opening is the slowest method of opening the canopy. The advantage of this method is that there is no fire hazard. The disadvantages are time to abandon and the fact that unknown fuselage damage could bind the canopy and possibly prevent its opening.
- Electrical opening of the canopy has the advantage of speed and no physical exertion. However the disadvantages in addition to those for manual opening, include a possible fire hazard due to actuation of an electrical circuit and uncertain canopy operation due to a battery of unknown condition of life.
- Jettisoning of the canopy is the fastest method of removing the canopy and does not have the disadvantages of the manual or electrical opening. However, the fire hazard is greater because of the canopy remover firing.
- If canopy cannot be opened, the canopy breaker tool may be used.

WARNING

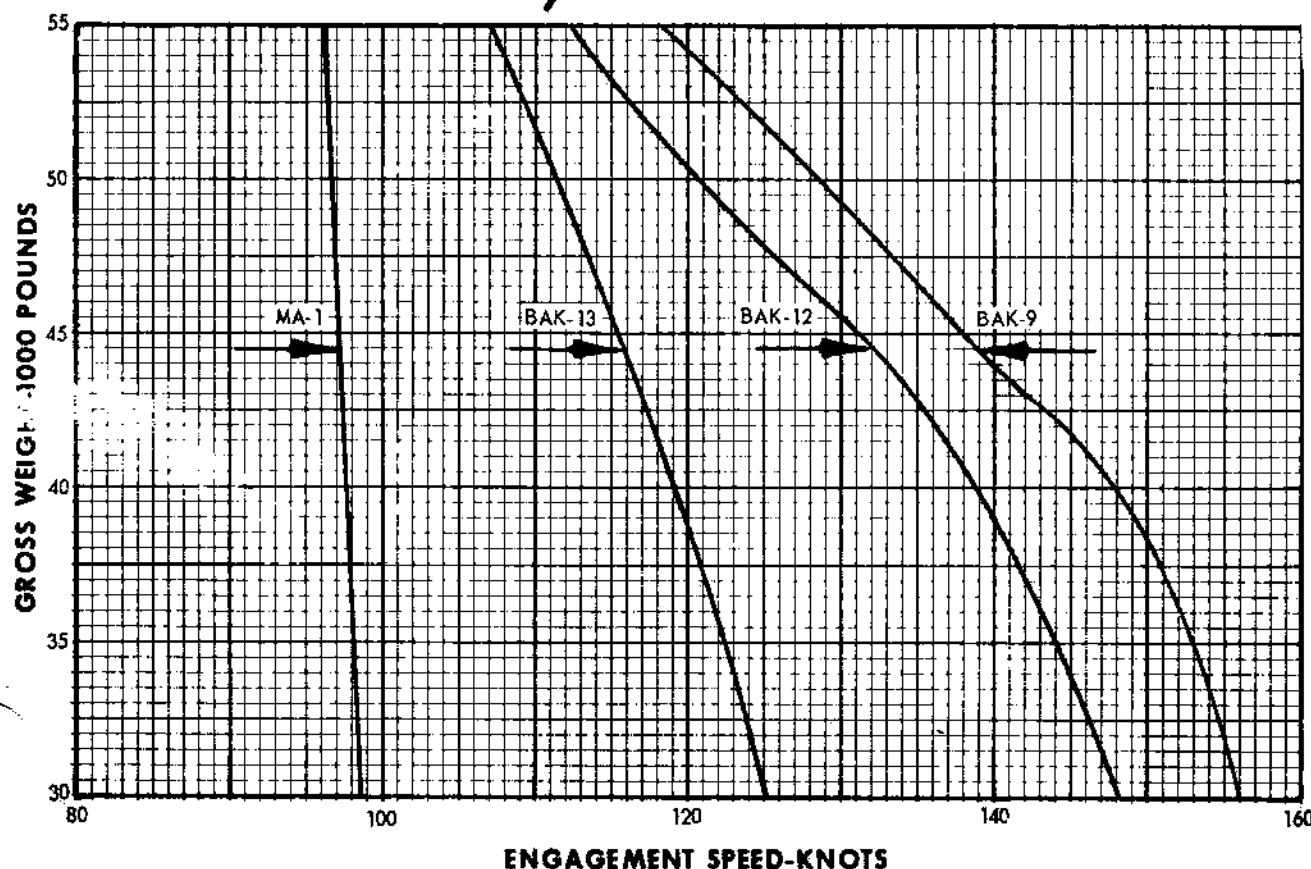
- If the cockpit contains fumes, manual opening is recommended to prevent possible fire.
- If the canopy is not fully closed, it is possible that it could not be jettisoned and would have to be opened manually or the plastic cut through with the canopy breaker tool.

ABORT.

1. THROTTLE — IDLE (OFF FOR FIRE AND EMERGENCY BRAKE — PULL).
2. EXTERNAL LOAD — JETTISON (if necessary).
3. DRAG CHUTE — DEPLOY.

If stores are jettisoned, delay deployment as long as possible to minimize possibility of stores over-taking aircraft.

ARRESTING HOOK / BARRIER **limits**



Note

These limits are based on a hook yield strength of 49,000 pounds. The speeds shown for the various gross weights are the maximum speeds that the aircraft can engage the barrier without failing the hook.

CAUTION

Due to the many configurations of arresting barriers and various combinations of installations, only data on Air Force barriers are included in the Flight Manual. These barriers can be safely engaged if the above limitations are followed. Engagement of other barriers should not be attempted as data is not available on the stress imposed on the arresting gear with other systems. Catastrophic failure will occur if the hook is overloaded. Especially front end and mid-field engagements should not be attempted as structural failure will occur.

MAXIMUM ARRESTING SYSTEM ENGAGING SPEEDS			
AIRCRAFT WEIGHT	ENGAGING SPEED - KNOTS		
POUNDS	BAK-9	BAK-12	BAK-13
30,000	156	148	125
32,000	155	147	124
34,000	154	145	123
36,000	152	143	122
38,000	150	141	120
40,000	148	139	119
42,000	144	136	117
44,000	140	133	116
46,000	136	129	114
48,000	132	125	113
50,000	128	121	111
52,000	124	117	110
54,000	120	114	108

Figure 3-1

4. ARRESTING HOOK — EXTEND.

5. Brakes — Apply optimum.

- If emergency brake handle is pulled, antiskid is inoperative.
- If a main tire fails, antiskid switch — OFF, use differential braking and nose wheel steering, as vibration increases the brake should be held and locked on the failed tire.

6. Attempt to engage barrier squarely.

Normally the throttle will be positioned to IDLE which will permit aircraft to taxi clear of runway after hook engagement. *If the throttle is positioned to OFF, accomplish as much of the following as possible prior to engaging barrier.*

- Emergency brake — PULL.
-  Shoulder harness — LOCKED.
- Fuel tank selector switch — OFF [997C and 1044] N/C/W.
- Fuel shutoff switch — SHUTOFF [997C or 1044] C/W.

e. Battery switch — OFF.

CAUTION

When the aircraft is approaching the barrier with the nose extremely low, and it is imperative that the barrier cable be engaged, the brakes should be released prior to crossing the cable.

LANDING GEAR RETRACTION ON THE GROUND.

Retracting the landing gear while on the ground should be considered only as a LAST RESORT. However, it is conceivable that a situation might arise wherein retracting the landing gear while the weight of the aircraft is on the main struts might be considered necessary. If so, proceed as follows:

- Landing gear downlock override switch — Hold actuated, then move gear handle — UP.

Actuate the override switch before moving landing gear handle. (DC power and utility hydraulic pressure must be available.)

2. Throttle — OFF.

If time and circumstances permit, do as many of the following, as possible.

- a.  Shoulder harness — LOCKED.
 - b. Fuel tank selector switch — OFF [997C and 1044] N/C/W.
 - c. Fuel shutoff switch — SHUTOFF [997C or 1044] C/W.
 - d. Battery switch — OFF.
3.  Evacuate aircraft.

EMERGENCY GROUND EVACUATION.

WARNING

The parachute should be removed and all personal leads disconnected before the canopy is opened or jettisoned, to aid in exiting the aircraft as rapidly as possible.

1.  Open safety belt, disconnect personal leads.
 - a. Electrical.
 - b. Oxygen — Disconnect mask hose from connector.
 - c. Anti G suit.
 - d. Vent suit.
2.  Remove parachute.

WARNING

If the parachute is retained the survival kit emergency release handle must be pulled all the way up prior to lifting the kit as lifting the kit will arm it.

If the kit is lifted more than one inch prior to pulling the emergency release handle the life raft will inflate when the handle is pulled.

Note [1038] C/W

If the parachute is retained, stand up and pull on the parachute firing cable. It will separate from the parachute deployment gun actuator without firing the deployment gun.

3.  Canopy — Open or jettison as required.
 - a. Manual opening.

- (1) Canopy lock lever — Unlock.
- (2) Canopy actuator release — Actuate.

☐ T handle — Pull forward.

☐ Pip pin — Remove, lever move forward.

- (3) Raise canopy manually and hold up. Automatic uplocks are not provided.

- b. Electrical (normal) opening.

- (1) Canopy lock lever — Unlock.
- (2) Canopy control switch — Hold to OPEN.

- c. Jettison.

Auxiliary canopy jettison handle — Actuate.

Canopy will jettison without arming the ejection seat.

- d. If canopy cannot be opened, cut through canopy using canopy breaker tool.

Use a double handgrip and penetrate both layers of plastic by exerting maximum force.

Aim each blow into clear plastic as near the edge as possible.

4.  Exit from aircraft.

WARNING

Because of the height of the cockpit above the ground, care should be exercised when evacuating the aircraft without a ladder.

TAKEOFF.

This phase of operation is from the time the throttle is advanced for takeoff until the aircraft is cleaned up and initial climb established.

ZOOM MANEUVER.

In the event of loss of thrust, fire or overheat indication during takeoff when it is too late to abort (or during flight at low altitude with sufficient airspeed available) the aircraft should be pulled up (zoom) to exchange airspeed for an increase in altitude. This will allow more time for accomplishing subsequent emergency procedures (air start, establishing forced landing pattern, ejection, etc.). Maximum altitude gain can be achieved by jettisoning external stores prior to zoom. The decision to jettison or retain external stores must be made by the pilot on the basis of his evaluation of the particular failure and conditions existing at the time of the emergency. The point at which climb should be terminated will depend on whether the pilot intends to eject or whether he intends to continue attempting air starts, establish forced landing pattern, etc. In any event, it is recommended that an air start be attempted immediately upon detection of engine flame-out and repeated as many times as possible. If the decision is to eject, the aircraft should be allowed to climb as far as possible. The optimum zoom technique is to pull the aircraft up with the wings level until initial buffet is encountered. Hold this condition until the speed drops to 200 KIAS or an altitude of 2000 feet is reached. If the decision is to continue attempting air starts, the climb should be terminated prior to the airspeed dropping below best glide speed in order to obtain maximum glide distance and maintain adequate engine windmilling RPM for air start. See figure 3-2 for maximum glide.

ENGINE FAILURE DURING TAKEOFF.

If Decision is Made to Stop:

1. ABORT.

If Takeoff is Continued:

1. EXTERNAL LOAD — JETTISON.

2. ZOOM, IF POSSIBLE, AND EJECT.

Ejection should be accomplished while the aircraft is in a positive climb.

If an emergency landing must be made, perform as much of the following as possible.

3. RAT lever — EXTEND.

Move forcefully to the full forward position with no hesitation in the mid travel area. There should be no control movement during RAT lever movement.

4. Landing gear emergency extension handle — Pull.

5. Flap lever — LANDING & TAKEOFF.

6. Throttle — OFF after touchdown, emergency brake — Pull.

Only three full brake applications available, and antiskid will be inoperative.

7. Drag chute — Deploy.

8. Arresting hook — EXTEND.

9. Fuel tank selector — OFF [997C and 1044] N/C/W.

10. Fuel shutoff switch — SHUTOFF [997C or 1044] C/W.

11. Battery switch — OFF.

AFTERBURNER FAILURE DURING TAKEOFF.

If Decision is Made to Stop:

1. ABORT.

If Takeoff is Continued:

1. THROTTLE — MILITARY.

Throttle inboard permits nozzle to close.

Do not attempt to relight A/B during remainder of takeoff as it will keep nozzle open.

Open nozzle will be indicated by low EPR at MILITARY THRUST.

2. EXTERNAL LOAD — JETTISON (if necessary).

Rotation speed and takeoff speed must be increased if external load is not jettisoned.

ENGINE FIRE DURING TAKEOFF.

If Decision is Made to Stop:

1. ABORT.

If Takeoff is Continued:

1. THROTTLE — MAINTAIN TAKEOFF THRUST TO SAFE EJECTION ALTITUDE.
If aircraft speed is at or below 225 KIAS, ejection can be accomplished at zero altitude [1038] C/W.
2. EXTERNAL LOAD — JETTISON (if necessary).
3. FIRE EXTINGUISHING MANUAL DISCHARGE SWITCH (1060) C/W DISCHARGE.
4. IF CONFIRMED FIRE CONTINUES — EJECT.
5. If overheat light alone is illuminated, speed brakes — Open partially.

Note

Failure of the exhaust nozzle to open when the afterburner is started will be indicated by a rapid rise in exhaust gas temperature and decrease in RPM. To prevent over-temperature condition, the afterburner must be cut off as soon as possible.

6. If fire cannot be verified, reduce throttle to minimum practical thrust and land as soon as possible or eject.

TIRE FAILURE DURING TAKEOFF.

Tire failure on takeoff may present more problems than tire failure on landing. Directional Control is more difficult and braking efficiency is greatly reduced at higher gross weights with failure of one or both main gear tires.

If Decision is Made to Stop:

1. ABORT.
2. ANTISKID — OFF.

If Takeoff is Continued:

1. EXTERNAL LOAD — JETTISON (if necessary).
2. DO NOT RETRACT GEAR.

Note

If it can be determined that the blown tire has been torn from the wheel, the gear may be retracted, depending upon mission urgency.

LANDING GEAR FAILS TO RETRACT OR INDICATES UNSAFE.

In the event the landing gear cannot be retracted as a result of a malfunction of the landing gear system, ATM/utility hydraulic system failure, the warning lights fail to illuminate or the beeper fails to sound during retraction, the main consideration will be to sustain safe flight with the gear down. Whenever an unsafe gear up indication is obtained after retraction, assume the possibility of failure of the main landing gear positioning bracket with resultant cocking of the wheel. Before landing in this condition, request a visual check by another aircraft, mobile control or tower to ascertain whether the main wheel is cocked. A retracted gear that indicates unsafe may extend.

1. Maintain safe flying speed, with A/B, not to exceed 240 KCAS, minimize bank angles.
2. At safe altitude, throttle — Inboard.
3. If utility hydraulic pressure is available, attempt to retract gear.
 - a. Check four circuit breakers: LG WARNING LG POS, LG WARNING CONTROL AND LG (HANDLE) WARN LT — IN.
 - b. Landing gear — Cycle.

Move landing gear handle to DOWN and when all gear indicates down and locked, maintain straight and level flight and move landing gear handle to UP.
 - c. If landing gear handle is stuck in DOWN position, landing gear downlock override switch — Hold actuated, then move landing gear handle to UP.

4. If landing gear cannot be retracted or continues to indicate unsafe, landing gear handle — DOWN, observe 275 KCAS limit, reduce weight and make appropriate landing. The 275 KCAS with A/B should apply only when no control problems have been encountered.

5. If visual inspection by another aircraft, mobile control or tower verifies a cocked main wheel, and the decision is made to land, request runway be foamed to assist in making a safe landing.

INFLIGHT

This phase of operation is from the termination of takeoff to the initiation of landing.

JETTISON PROCEDURES.

When jettisoning external stores several factors must be considered:

- Types of stores.
- Impact area.
- Asymmetrical configuration.

Jettison limitations. (See section V.) Depending on the emergency, it may be advisable to jettison external stores outside the release limits and risk some damage to the aircraft.

At high speed jettisoned tank type stores occasionally exhibit characteristics of aerodynamic lift before entering a ballistic trajectory. This tendency is greater when tanks are jettisoned in a turn. Tanks have been observed in free flight for 1500 feet during which time they have gained as much as 3000 feet altitude.

WARNING

When jettisoning tanks in formation flights, aircraft should be in a line abreast at least 500 feet apart.

- When jettisoning in single flight, the pilot shall warn adjacent aircraft of his decision. Pilots of adjacent aircraft will exercise extreme watchfulness and, if possible, take a position forward and above the aircraft jettisoning the tanks.

- Should any external stores fail to release as planned, aircraft control may be marginal due to asymmetrical loading. Pilots should anticipate a release failure and be prepared to take corrective action immediately. If an accidental asymmetrical load is encountered in flight and control difficulties are experienced, jettison all external stores immediately.
- If an attempt is made to open the bomb bay doors electrically either by (a) depressing the bomb bay station select button with the bomb mode selector in the manual position or (b) depressing the freeze fire button with the bomb mode selector in any automatic position with the bomb bay station select button in, the centerline tank (650 or 450) will be jettisoned even though the bomb bay safety switch is in the OFF position.
- Following any attempted release or jettison, any conventional munition that does not separate from the aircraft should be considered armed and susceptible to inadvertent release during landing impact.

Following a normal release, all bomb dispensers and rocket launchers, except bomb dispensers and rocket launchers M-47 (Gravel), SUU-24 and SUU-25 (Flare), LAU-32B/A, LAU-59/A, all rockets with inert warhead used for training and training devices that require jettisoning of the entire pylon/launcher assembly, should be considered as still containing one or more bombs and/or rockets. If visual examination cannot positively confirm a safe condition, jettison prior to landing.

- After a SUU-13/A dispenser has been activated, it must be ejected or jettisoned prior to landing. This is to preclude return to base of any non-ejected or partially ejected munition clusters.

Inflight

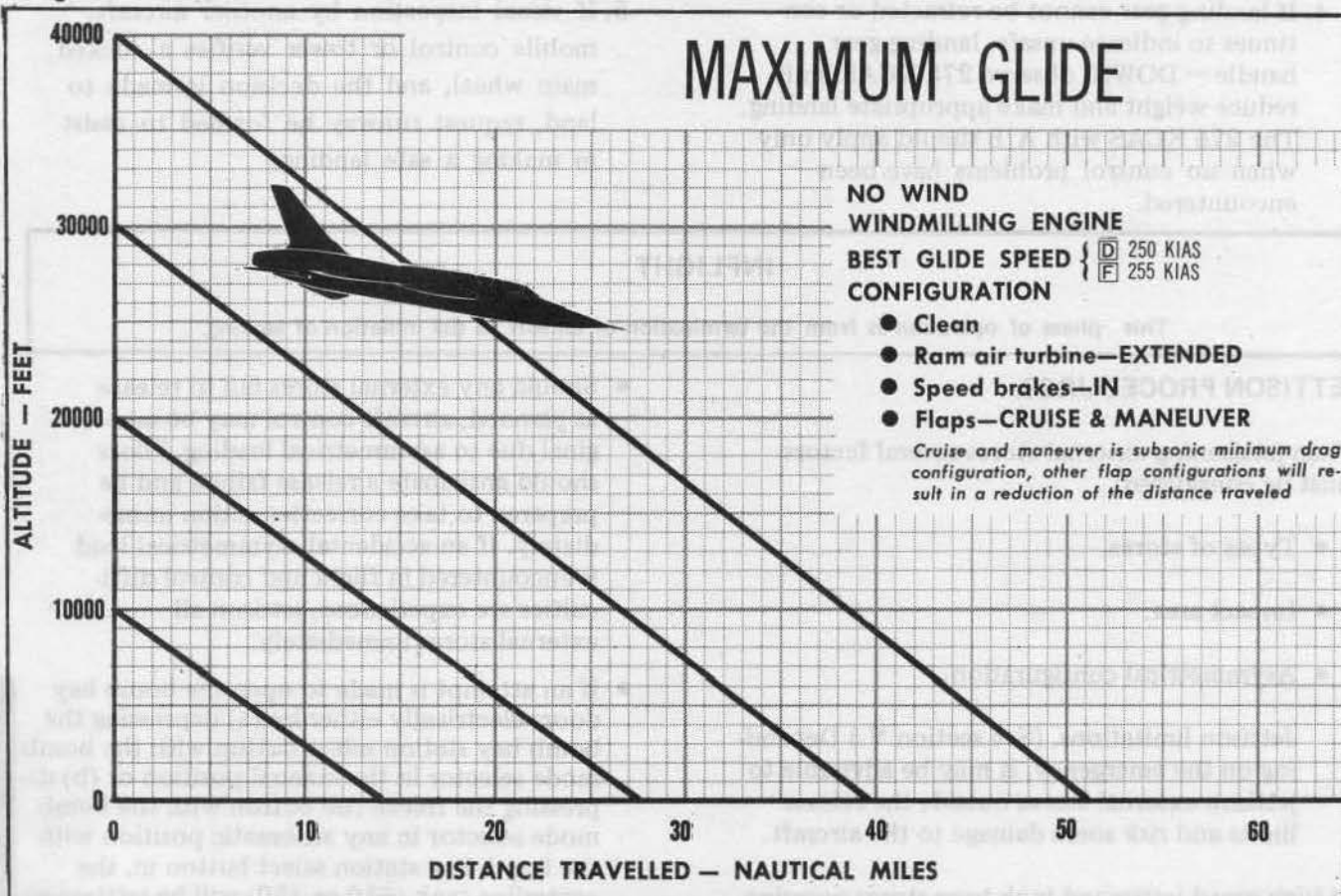


Figure 3-2

JETTISON ALL PYLONS (With Stores).

1. Jettison external stores button — Depress.

JETTISON OUTBOARD, INBOARD OR CENTER PYLON (With Stores).

1. Respective pylon jettison button — Depress.

JETTISON INBOARD MER.

1. When MER's are installed on inboard pylons, the cartridges are removed making this system ineffective. Pylon and MER's must be jettisoned together. This can be accomplished by using the selective pylon jettison button placarded INBD.

JETTISON CENTERLINE TANK (And Pylon).

1. Belly tank jettison switch [997C and 1044] N/C/W or centerline pylon jettison button — Actuate.

JETTISON AGM-12B.

1. GAM-83 jettison switch — Actuate (with DCU-59A) outboard or inboard pylon jettison switch — Actuate (with DCU-102A).

LAUNCH AIM-9B UNARMED.

1. Landing gear handle — UP.
2. Master armament switch — WEAPONS.
3. Pylon-sequence-selector switch — CONV ST JETT.
4. Outboard station selectors — Depress.
5. Bomb arming switch — SAFE.
6. Freeze/fire button — Depress.

JETTISON SUU-21/A, MULTIPLE WEAPON PYLON CENTERLINE (DCU-102A).

1. BB/C station selector switch — ON (up).
2. Special weapons pylon jettison switch — Actuate (up).

ENGINE FAILURE.

Engine failure is defined as a loss of thrust, caused by engine material failure or a flame-out. System caution lights, engine instruments and operating

characteristics often give indications of impending engine failure. Reduction of thrust and minimizing G forces will generally prolong the engine operating time prior to engine material failure. Flame-outs are generally due to improper fuel scheduling caused by fuel system malfunction or improper fuel system management. Appropriate operating procedures may prevent a flame-out. Because of the many variables associated with an engine failure it is impossible to establish a predetermined set of rules which would provide a ready-made procedure applicable to all circumstances. Also, because of the many variables encountered, the final decision must remain with the pilot as to which procedure he will follow. See figure 3-2 for maximum glide.

Note

Normally the pilot will be concerned with AIR START, EJECTION, or FORCED LANDING. The basic decision factors associated with these procedures are presented as a guide to assist the pilot in selecting the best procedure or combination of procedures for his particular circumstances.

EMERGENCY FUEL SYSTEM OPERATION.

The emergency fuel system may be used any time failure of the normal fuel control system is suspected. The system may be selected at any RPM or throttle setting. When making an air start, if the EMERG FUEL SYS ON caution light is delayed in illuminating, a delay in relight must be anticipated. This is due to the time required to prime the engine driven fuel pump and provide pressure which will transfer the fuel flow from the normal system to the emergency system. When operating on the emergency fuel system, the throttle must be moved slowly to avoid exceeding RPM and EGT limits. Monitor RPM and EGT and control with throttle. The afterburner may be started and operated when operating on the emergency fuel system, but the extended A/B range should not be used.

AIR START.

AIR START/DECISION FACTORS.

- Air start is not possible and should not be attempted following complete engine failure, (engine seizure or explosion).
- Immediate air starts may be possible at any altitude providing RPM has not decreased appreciably.
- The best glide and air start speed is ☐ 250, ☐ 255 KCAS. Maintaining this speed whenever possible will help insure an air start as the aircraft will be in a near level attitude and the fuel tank gravity feed ports will be covered even if fuel quantity is low. (See figure 3-2.)
- Air start probability increases below 30,000 feet. (See figure 3-3.)
- Fuel supply must be available for air start and will be indicated on the fuel flow indicator. The fuel flow indicator is powered by the standby inverter during a flame-out.
- If the emergency fuel system is selected, illumination of the EMERG FUEL SYS ON caution light indicates that fuel pressure from the engine driven fuel pump unit has transferred the fuel flow to the emergency fuel system.

AIR START PROCEDURE.

Ignition is initiated each time the air start or cart-ridge start button is depressed and continues for 20 seconds after the button is released. The 20 second ignition cycle is also initiated when the emergency fuel system is selected. However, ignition is not supplied to the ignition plugs (or fuel flow to the engine) until/unless the throttle is out of the OFF position. The standby airspeed indicator and altimeter must be used as the integrated instruments will be inoperative. See figure 3-3 for airspeed and altitude for obtaining consistent air starts. The tachometer will probably give the first indications of successful air start as the EGT gage has a relatively slow response rate.

Low Altitude.

1. THROTTLE — INBOARD.

If time permits, attempt to readjust throttle to match RPM indication.

2. EMERGENCY FUEL — SELECT.

Ignition will be supplied automatically for approximately 20 seconds.

3. ZOOM.

High Altitude.

1. Throttle — Inboard.

If time permits, attempt to readjust throttle to match RPM indications.

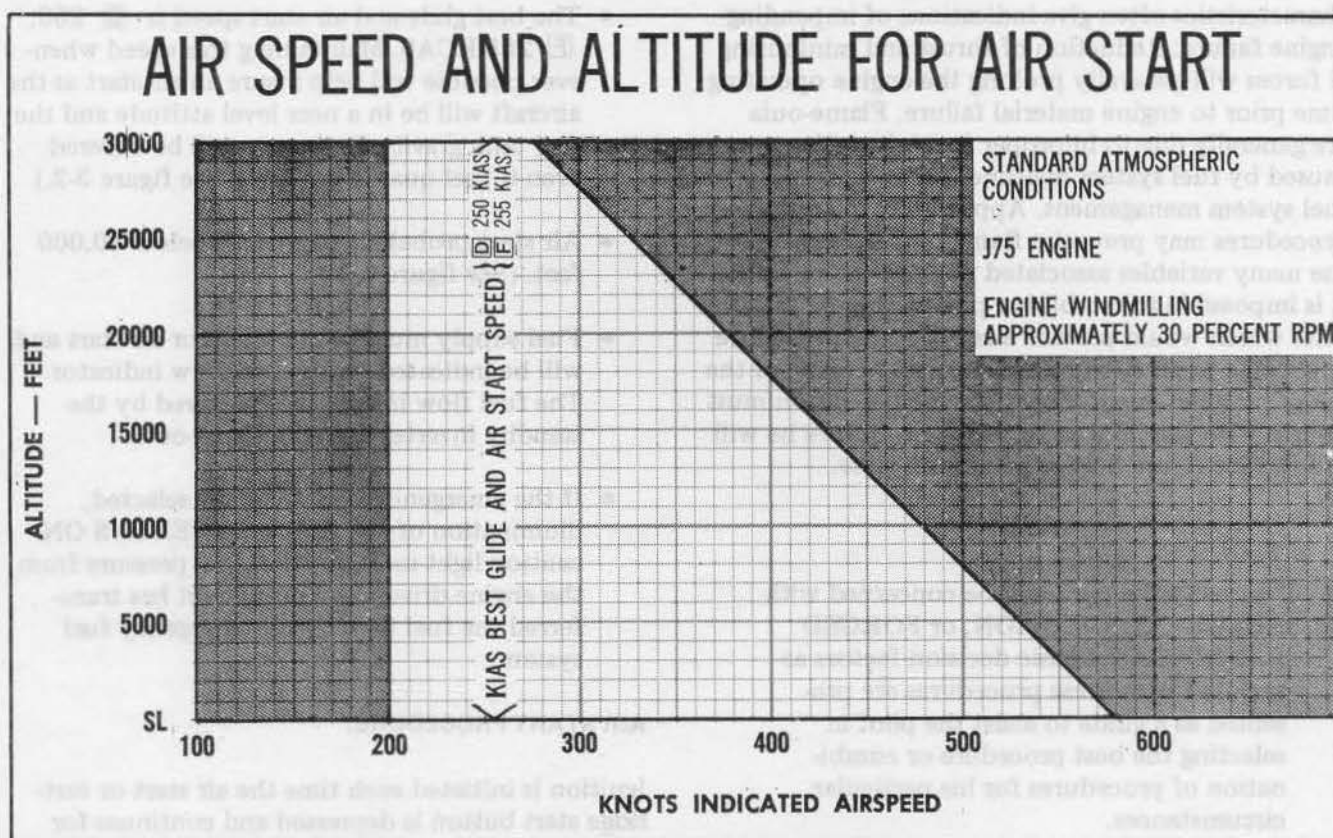


Figure 3-3

2. Air start button — Depress.

If relight is not obtained and conditions permit:

3. Throttle — IDLE.

4. RAT lever — EXTEND.

Move forcefully to the full forward position with no hesitation in the mid travel area. If possible do not move controls during RAT lever movement.

5. Glide speed — **D** 250, **F** 255 KIAS (standby).

Use the standby airspeed indicator and altimeter as the integrated instruments will be inoperative.

6. Battery switch — Recheck ON.

7. *If normal fuel system failure is suspected,*
emerg fuel system — Select.

Ignition will be supplied automatically for approximately 20 seconds.

Note

- If the emergency fuel system caution light is delayed in illuminating, a delay in relight must be anticipated.

8. Reattempt air start.

a. Air start button — Depress.

Maintain throttle at IDLE until start is successful or positive indications of steady fuel flow.

Note

If air start button fails to supply ignition use the cartridge start button. The cartridge start button will not provide ignition with the emergency fuel switch in EMERG FUEL SYSTEM.

b. Air start button — Depress every 20 seconds.

9. Engine instruments — Check.

10. After successful air start.

a. Throttle — As required.

b. RAT lever — RETRACT.

Move forcefully to the full aft position with no hesitation in the mid travel area. There should be no control movement during RAT lever movement.

c. ATM switch — START.

d. AC generator switch — RESET, then ON.

Note

If an unsuccessful airstart occurs, and if sufficient altitude is available, move the throttle to OFF briefly (3 to 5 seconds) which will allow the ignition plugs to be blown dry before attempting another airstart. Reaccomplish High Altitude airstart procedure.

EJECTION.**EJECTION/DECISION FACTORS.**

- Dive or spin condition, eject at least 15,000 feet above terrain where possible.

Ejection should not be delayed when the aircraft is descending and cannot be leveled out.

- Level flight, eject at least 2000 feet above terrain where possible.

Below 2000 Feet

During any low altitude ejection, the chances for successful ejection can be greatly increased by zooming the aircraft (if airspeed permits) to exchange airspeed for altitude. Ejection should be accomplished while the aircraft is in a positive climb. This will result in a more vertical trajectory for seat and pilot, thus providing more altitude and time for seat separation and parachute deployment. Refer to zoom maneuver in this section.

WARNING

Accident statistics show a progressive decrease in successful ejections as altitude decreases below 2000 feet.

- Emergency minimum altitudes for ejection [1038] N/C/W.

Emergency minimum ejection altitudes are 100 feet with the zero delay lanyard connected and 200 feet with the lanyard stowed. These altitudes are based on a minimum airspeed of 120 KCAS in a 1G climb or level flight and with a 1 second automatic lap belt and a BA-15 or 18 parachute with a F-1B timer set at 1 second. A minimum 120 KCAS is required to assure complete parachute deployment at the greatest height above the terrain.

WARNING

The above altitudes were determined through extensive sled tests and are based on altitude above terrain on initiation of seat ejection (i.e., time seat is fired). These figures do not provide any safety factor for such matters as equipment malfunction, delays in separating from the seat, etc. These figures are quoted only to show the minimum altitude you must go up to in the event of low altitude emergencies such as a fire on takeoff. They shall not be used as the basis for delaying ejection when above 2000 feet since accident statistics show progressive decrease in successful ejection as altitude decreases below 2000 feet. Therefore, whenever possible, eject above 2000 feet. To ensure survival during extremely low altitude ejections the automatic features of the equipment must be used and depended upon.

Figures 3-4 and 3-5 show the safe altitude and airspeed ejection envelope. These charts are based upon sufficient upward velocity to provide time for the parachute to fully deploy and lower the pilot to the ground. The unsafe zone below 550 knots presents the envelope where the pilot would have insufficient vertical velocity because of the increased wind resistance at the higher airspeeds, to permit adequate time for parachute deployment. 550 knots is the maximum recommended airspeed for ejection. The zoom maneuver should be utilized whenever airspeed permits.

- Emergency minimum altitudes for ejection [1038] C/W.

EJECTION ENVELOPE—VELOCITY

[1038] C/W

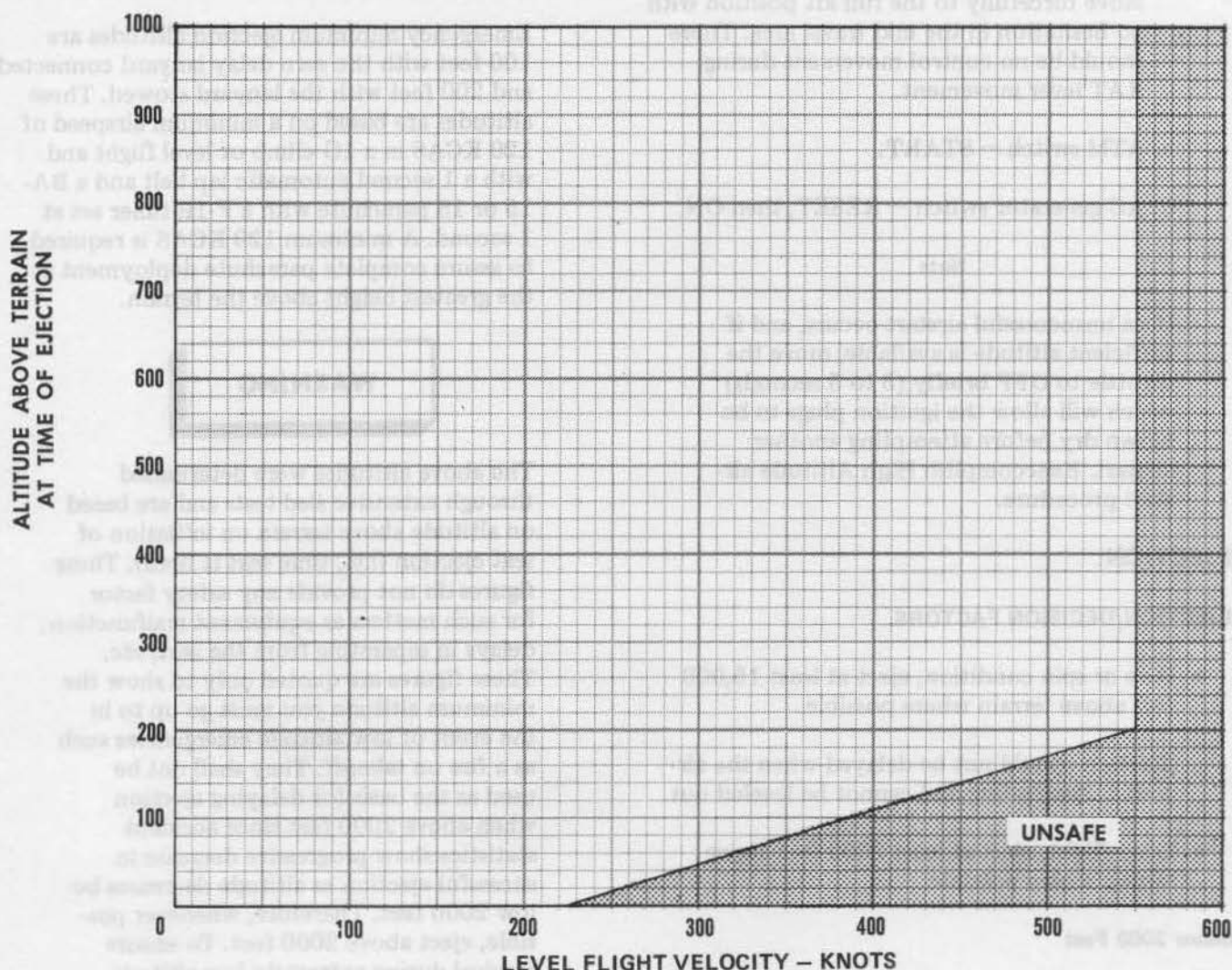


Figure 3-4

Emergency minimum ejection altitudes with the force-deployed parachute are zero feet up to 225 KIAS and then progressing linearly up to 200 feet altitude at 550 KIAS. (See figure 3-4.)

When the aircraft is descending, the emergency minimum ejection altitudes progress from zero rate of descent at zero feet above terrain to 200 feet at 6000 feet per minute rate of descent, increasing to 400 feet at 10,000 feet per minute. (See figure 3-5.)

WARNING

The above altitudes were determined through extensive sled tests and are based

on altitude above terrain on initiation of seat ejection (i.e., time seat is fired). These figures do not provide any safety factor for such matters as equipment malfunction, delays in separating from the seat, etc. These figures are quoted only to show the minimum altitudes you must go up to in the event of low altitude emergencies, such as a fire on takeoff. They shall not be used as the basis for delaying ejection when above 2000 feet since accident statistics show progressive decrease in successful ejection as altitude decreases below 2000 feet. Therefore, whenever possible, eject above 2000 feet. To insure survival during extremely low altitude ejections the automatic features of the equipment must be used and depended upon.

EJECTION ENVELOPE—RATE OF DESCENT

[1038] C/W

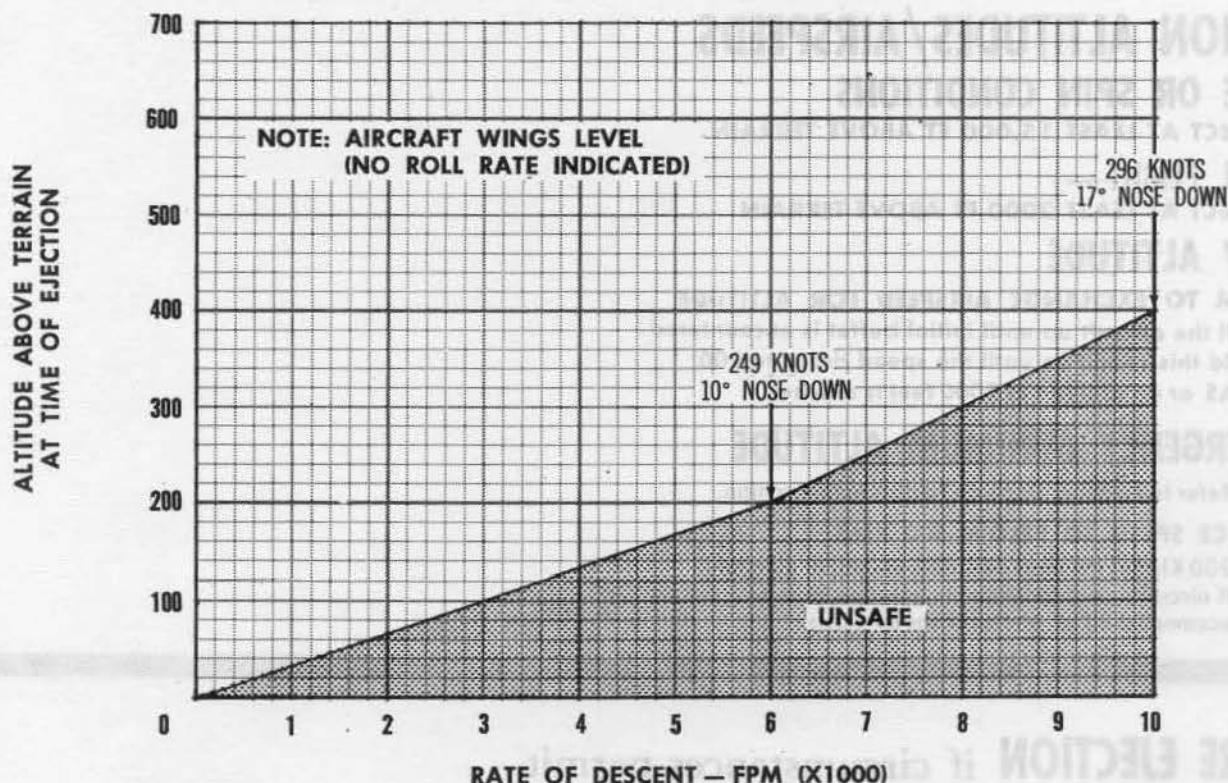


Figure 3-5

Note

These altitudes are based on a 1G climb or level flight.

- These altitudes are based on the aircraft wings being level at the time of ejection with no roll rate occurring.
- Air speed may be exchanged for altitude by jettisoning stores and zooming.

Maximum altitude can be achieved by jettisoning external loads before zoom. The further up the climbing flight path that external loads are jettisoned the less additional altitude will be gained.

- If ejection is initiated when the aircraft is in a climbing 1G attitude chute deployment will be at a higher altitude than if initiated from level flight.
- 200 KIAS is the most desirable speed for ejection.

Above 200 KIAS windblast exerted on the body at sea level will be as follows:

up to 525 KIAS — minor

525 to 600 KIAS — appreciable

above 600 KIAS - excessive

As altitude is increased, these speed ranges will be proportionally lower.

WARNING

The maximum speed for ejection, based on the qualified capabilities of the escape system is 500 KIAS [1038] N/C/W and 550 KIAS [1038] C/W. Every effort should be made to reduce speed.

EJECTION PROCEDURE.

See figure 3-6.

DIVE OR SPIN CONDITIONS

LEVEL FLIGHT —

LOW ALTITUDE

KIAS or an altitude of 2000 feet is reached.

EMERGENCY MINIMUM ALTITUDE

REDUCE SPEED TO BELOW 500 KIAS

accomplished at whatever speed exists.

BEFORE EJECTION if circumstances permit

- Head aircraft away from populated area**

-  When ejecting under controlled conditions and at more than 2000 feet above ground level — Disconnect the zero delay lanyard [1038] N/C/W

**DO NOT ATTEMPT TO CONNECT THE ZERO
DELAY LANYARD AFTER DECIDING TO EJECT**

Landing gear emergency extension handle — Push full forward if extended.

- ✖ Loose equipment stow and pull visor down (if applicable).
- ✖ At high altitude — bailout bottle ball handle — Pull, temperature control handle — RAM. Throttle — OFF.
- ✖ Sit erect with head hard against headrest, chin tucked in.
- ✖ Arms on arm rests.
- ✖ Pelvis firmly against back of seat.
- ✖ Thighs resting on seat.
- ✖ Feet on rudder pedals. Do not place heels against seat as this will raise thighs off the cushion.

DO NOT MANUALLY OPEN THE SAFETY BELT

Change 2

EJECTION PROCEDURE

F 1. ORDER CREW MEMBER TO EJECT.

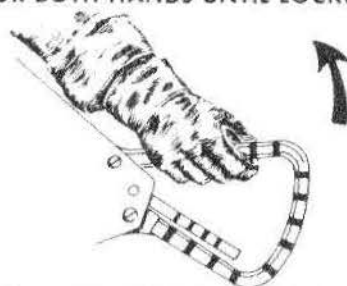
USE THE INTERPHONE, OR IF INOPERATIVE, POSITION BAIL-OUT SWITCH TO BAIL-OUT.

WARNING

F Simultaneous ejections must be avoided. The rear occupant should eject first since full command of the aircraft can only be exercised from the front cockpit.

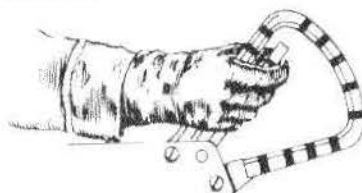
2. LEG BRACES — RAISE.

RAISE LEG BRACE WITH EITHER OR BOTH HANDS UNTIL LOCKED



3. TRIGGERS — SQUEEZE

(Canopy will jettison and three tenths of a second later seat will eject). One trigger will actuate the ejection procedures.



IF SEAT FAILS TO EJECT AND CANOPY DID NOT JETTISON,

accomplish as many of the following steps as necessary:

- Auxiliary canopy jettison handle — Actuate.
- Canopy lock lever — Unlock.
- Canopy control switch — Hold to OPEN.
- Canopy actuator release handle — Actuate, then push canopy open manually.
- Parachute firing cable — Disconnect [1038] C/W
- Survival kit emergency release handle — Pull.
- Safety belt — Release. On aircraft [1083] C/W, pull leg lanyards through leg garters.
- Bail out bottle — Actuate.
- Personal equipment leads — Disconnect.
- Trim — Nose down.
- Invert aircraft.
- Release stick and push free.

Keep positive G load until inverted; then quickly release stick and push free of seat.

NOTE

If aircraft is not controllable, slow down as much as possible and bail out over the side.

AFTER EJECTION

1. Immediately after ejection — Attempt to manually open the safety belt. *It will be impossible to beat the automatic operation unless it has failed.*

WARNING [1038] C W

If you have ejected above an altitude of 15,500 feet, the aneroid device in the parachute deployment gun will delay the firing of the gun until the parachute falls below the 15,500 foot altitude. If you elected to pull the ripcord "T" handle rather than permit the parachute to automatically force-deploy, you must be provided with bottled oxygen or at an altitude where natural oxygen is sufficient to permit a safe parachute descent. At low altitudes, the automatic sequence of the deployment gun causing parachute force-deployment should be used due to the more rapid deployment. However, if the deployment gun has not fired by a count of three after seat-man separation, pull the ripcord "T" handle.

2. As soon as the belt is open — Make a determined effort to separate from the seat to obtain full parachute deployment at maximum terrain clearance: *This is extremely important for low altitude ejection.* [1038] N C W.
3. If you opened the safety belt manually, *the automatic feature of the parachute is eliminated* [1038] N C W *therefore*:
 - a. If below 14,000 feet — Pull the ripcord grip.
 - b. If above 14,000 feet — Pull the arming lanyard.
4. All ejections below 14,000 feet — Pull the ripcord grip. *This is a precaution since the parachute should deploy automatically* [1038] N C W.

AFTER PARACHUTE IS FULLY DEPLOYED AND STABILIZED.

1. When below 14,000 feet or if oxygen supply is depleted — Remove oxygen mask.
2. Survival kit emergency release handle — Pull.
3. If over water — Inflate life preserver.

Figure 3—6 (Sheet 2 of 2)

ENGINE FIRE DURING FLIGHT.

1. THROTTLE — MINIMUM PRACTICAL POWER.
2. FIRE EXTINGUISHING MANUAL DISCHARGE SWITCH (1060) C/W — DEPRESS.
3. IF CONFIRMED FIRE CONTINUES — EJECT.
4. If overheat light alone is illuminated. Speed brakes — Open partially.

Note

- Failure of the exhaust nozzle to open when the afterburner is started will be indicated by a rapid rise in exhaust gas temperature and decrease in RPM. To prevent over-temperature condition, the afterburner must be cut off as soon as possible.
 - Failure of the engine exhaust nozzle to close when the afterburner is shut down will result in a loss of thrust and illumination of the overheat warning light. Recycling the A/B and/or descending to a lower altitude may close nozzle and extinguish the overheat caution light.
5. If fire cannot be verified, reduce throttle to minimum practical thrust and land as soon as possible or eject.

COMPT O'HEAT LIGHT.

Illumination of the compartment overheat light may be caused by a failed cooling turbine, overheated electrical equipment or an overheated battery. Accomplish as much of the following as necessary until the light goes out.

1. Avoid high indicated air speed.
2. Electronic compartment cooling switch — OFF.
3. Fire control power switch — OFF.
4. Battery switch — OFF.
5. a. If light remains on — Land as soon as possible.
- b. If light goes out — Electronic compartment cooling switch ON.
6. If light remains out — Fire control power switch ON.
7. Land as soon as practical.

ATM AIR LINE O'HEAT LIGHT.

Illumination of the ATM AIR LINE O'HEAT caution light indicates excessive temperature adjacent to the engine hot air line between the ATM pressure regulator/shutoff valve and the ATM. The overheat condition is caused by a leak or break in the hot air line which can result in damage to the aircraft structure and equipment. The ATM must be shut down to prevent any leakage of hot air into the equipment compartments and will result in the AC/generator, utility hydraulic system, VAI system and windshield rain removal system becoming inoperative. Systems requiring AC secondary power and utility hydraulic pressure for operation will be inoperative. Afterburner operation may not be possible because the speed brakes may not open or hold in the afterburner position. If the afterburner is operating when the ATM is shut down it will continue to operate even though the speed brakes do not remain in the afterburner position, until shut down normally or mechanically by the pilot.

WARNING

When the ATM is shut down due to an overheat condition, DO NOT start it again, otherwise hot engine air will again leak into the compartment(s) resulting in an overheat condition.

1. ATM switch — Hold to STOP and check that AC GEN caution light illuminates.
2. ATM AIR LINE O'HEAT light should go out within 5 seconds after the ATM switch is placed at STOP.
3. Follow Gravity Fuel Feed Procedure for cruise and descent and procedures for "LANDING with GRAVITY FUEL FEED" and "UTILITY HYDRAULIC SYSTEM INOPERATIVE."
4. If ATM AIR LINE O'HEAT light remains ON:
 - a. AC GEN CONTROL circuit breaker — Check IN.
 - b. If light remains illuminated:
 - (1) Oxygen diluter lever — 100% OXYGEN.
 - (2) Main hot air line shutoff valve switch — OFF, reduce speed to subsonic.

Note

If aircraft is supersonic when the main air line switch is placed OFF the VAI system will become inoperative and the engine bleed doors will "free wheel" (assume positions as determined by duct pressure) and the duct plugs will lock in the position existing at the time utility hydraulic pressure is lost.

- If the duct plugs have not returned to the subsonic configuration (full aft) a maximum thrust loss of 12 percent will result. However, a go around may still be accomplished if required.

- (3) Cockpit will depressurize.
- (4) ATM AIR LINE O'HEAT light should go out.
- (5) Electronic cooling switch — OFF.

WARNING

If the MAIN AIR LINE shutoff valve switch is placed OFF due to an overheat condition DO NOT place ON or remove all DC power, as either action will open the main air line shutoff valve resulting in hot engine bleed air to again leak into the compartments.

- c. Fuel in auxiliary tanks cannot be recovered.
- d. Jettison external fuel tanks as required.
- e. If ATM overheat light goes out, land as soon as practical. If ATM overheat light stays on, land as soon as possible. Use procedures for "LANDING with GRAVITY FUEL FEED" and "UTILITY HYDRAULIC SYSTEM INOPERATIVE."
- f. Make UHF transmissions only during the ON cycles of the ARC-70 radio.

Note

Windshield rain removal, defogging and defrosting are not available with the MAIN AIR LINE switch OFF.

- During a landing with the main hot air line shutoff valve switch in the OFF position (AC generator and air conditioning packages inoperative) the ARC-70 radio will cycle off approximately one and one-half minutes after the landing gear is extended and continue to cycle on and off at approximately one and one-half minute intervals.

5. If ATM AIR LINE O'HEAT light still remains illuminated with main hot air line switch OFF and the *cockpit has depressurized*, it can be assumed there is a malfunction in the detector circuit. However, leave the main hot air line switch OFF and comply with preceding steps 4c through 4f.
6. If ATM AIR LINE O'HEAT light remains illuminated after main hot air line shutoff valve switch is OFF, but the *cockpit has not depressurized*:
 - a. AC GEN CONTROL circuit breaker — Check IN.
 - b. If cockpit does not depressurize and light still remains illuminated:
 - (1) Comply with preceding steps 4c through 4f.
 - (2) Monitor aircraft for fire.
 - c. If cockpit depressurizes and light goes out, comply with preceding steps 4c through 4f.

MAIN AIR LINE O'HEAT LIGHT.

Illumination of the MAIN AIR LINE O'HEAT caution light indicates excessive temperature adjacent to the hot air line between the main air line shutoff valve and the ATM pressure regulator/shutoff valve. The overheat condition is caused by a leak or break in the hot air line which can result in damage to the aircraft structure or equipment. The main hot air shutoff valve must be shutdown if a leak or break in the line occurs to prevent hot air leakage into any compartment adjacent to the leak. When the shutoff valve is closed it will result in the cockpit air conditioning package, electronic cooling package, ATM, utility hydraulic system, AC generator, VAI system, auxiliary fuel tank pressurization (fuel in auxiliary tanks cannot be recovered), anti-G suit and windshield rain removal, defogging and defrosting becoming inoperative. The fuel dive vent system shutoff valve will remain open but the regulator will function

(a jet penetration can be accomplished). Systems requiring AC secondary power and utility hydraulic pressure will be inoperative. Afterburner operation is as described under ATM AIR LINE O'HEAT LIGHT.

WARNING

If the MAIN AIR LINE shutoff valve switch is placed OFF due to an overheat condition, DO NOT place it ON or remove all DC power, as either action will open the main air line shutoff valve resulting in hot engine bleed air to again leak into the compartments.

1. Main hot air line shutoff valve switch — OFF.
2. MAIN AIR LINE O'HEAT light should go out within 5 seconds after main hot air line shutoff valve switch is placed OFF. Cockpit should depressurize, if not proceed to step 8.
3. Oxygen diluter lever — 100% OXYGEN as cockpit will depressurize.
4. Temperature control lever — RAM or OFF as desired.
5. Jettison external fuel tanks as required.
6. Land as soon as practical following procedures for "LANDING with GRAVITY FUEL FEED" and "UTILITY HYDRAULIC SYSTEM INOPERATIVE."
 - a. Make UHF transmissions only during the ON cycle of the ARC-70 radio.

Note

During a landing with the main hot air line shutoff valve switch in the OFF position (AC generator and air conditioning packages inoperative) and ARC-70 radio will cycle off approximately 1½ minutes after the landing gear is extended and continue to cycle on and off at approximately 1½ minute intervals.

7. If MAIN AIR LINE O'HEAT light still remains illuminated with main hot air line valve switch OFF, and the *cockpit has depressurized* assumed there is a malfunction in the detector.

However, leave the main hot air line valve switch OFF and comply with preceding steps 3 through 6.

8. If MAIN AIR LINE O'HEAT light still remains illuminated with the main hot air line valve switch OFF and the *cockpit has not depressurized*:
 - a. AC GEN CONTROL circuit breaker — Check IN.
 - b. If cockpit does not depressurize and light still remains illuminated:
 - (1) Comply with preceding steps 3 through 6 except "land as soon as possible."
 - (2) Monitor aircraft for fire.
 - c. If cockpit depressurizes and light goes out comply with preceding steps 3 through 6.

SMOKE OR FUMES IN COCKPIT.

If smoke or fumes (including non-visible eye burning fumes) enter the cockpit, the cause may be a fire, a failed engine bearing seal, a fuel leak in the engine compartment, a failed cooling turbine, or overheated electrical wires. Circuit breakers and fuses protect most of the electrical circuits and tend to isolate overloads that would possibly result in a fire. If a circuit in the cockpit is overloaded it will be evident by smoke and/or fumes.

1. OXYGEN DILUTE LEVER — 100%.
2. Oxygen emergency lever — EMERGENCY if fumes are still apparent.
3. Throttle — Retard.
4. a. If cooling turbine failure is suspected (could be indicated by excessive cockpit heat).
 - (1) Temperature control lever — HOT (not full forward to AUTO).

The HOT position minimizes the flow of air through the cooling turbine and reduces the turbine speed. If the smoke is eliminated, the lever may be progressively moved toward COLD until temperature is bearable or smoke is again evident.
 - (2) If smoke persists, temperature control lever — RAM.

Cockpit pressure will decay to ambient rapidly. At low altitudes and high airspeeds (especially at high outside air temperatures) high cockpit temperatures may result. Temperature may be reduced by reducing airspeed and/or increasing altitude.

- (3) If temperature control is not satisfactory — Temperature control lever — OFF.

b. If electrical fire is suspected.

- (1) AC generator switch — OFF.
- (2) DC generator switch — OFF.
- (3) Battery switch — OFF.
- (4) Temperature control lever — RAM.

Note

Battery switch must be ON for command radio, IFF/SIF operation and to transfer external fuel.

- To avoid shutdown of the ATM when battery switch is returned to ON, hold the ATM switch at START while positioning the battery switch to ON.

5. If smoke becomes intolerable or too toxic — Auxiliary canopy jettison handle — Actuate.

The auxiliary canopy jettison handle will jettison the canopy without arming the ejection seat.

6. If fire cannot be verified — Reduce throttle to minimum practical thrust and land as soon as possible or eject.

AFTERBURNER FAILURES.

AFTER A/B LIGHT UP — RAPID RISE IN EGT AND DECREASE IN RPM.

(Engine exhaust nozzle failed to open.)

1. Throttle — Inboard.

Terminate A/B operation to prevent engine over temperature.

A/B OPERATION — THRUST LESS THAN NORMAL.

(Engine fuel pump element failure.)

In the event of failure of the engine fuel pump element, the afterburner fuel pump element will automatically supply fuel pressure to the engine fuel control unit, and engine operation will be normal. A/B thrust output will be reduced approximately 25 percent. If the engine fuel control unit should also fail, the emergency fuel system can be selected.

A/B SHUTDOWN — A/B FAILS TO CUT OFF.

1. At appropriate airspeed and altitude, throttle — Recheck inboard and retard until A/B cuts off.
2. Throttle — Advance to desired thrust setting.

Note

If the A/B is cut off mechanically, an attempt to restart may be made in the normal manner although certain mechanical or electrical failures may prevent a successful restart.

AFTER A/B SHUTDOWN — O'HEAT LIGHT AND THRUST LESS THAN NORMAL.

(Engine exhaust nozzle failed to close.)

1. Speed brakes — Open partially.
2. Afterburner — Cycle.
3. a. If light goes out — Land as soon as practical.
- b. If light remains on — Follow procedure for ENGINE FIRE DURING FLIGHT.

With the engine exhaust nozzle stuck in the open position, at high altitude, sufficient thrust to maintain altitude may not be available. If high altitude must be maintained, afterburner may be used, and speed brakes positioned as desired. Lower altitudes may be necessary for a successful afterburner restart. At lower altitudes and lighter gross weights, Military thrust will be sufficient to maintain altitude. Recycling of the afterburner and/or descending to lower altitudes may close the nozzle.

HUNG RPM OR STUCK THROTTLE.

In the event engine RPM fails to respond to throttle manipulation, or the throttle cannot be moved, the malfunctions may be an internal failure of the normal fuel control or failure of the control linkage, proceed as follows.

1. If the throttle can be moved:
 - a. Descend below 30,000 feet.
 - b. Emergency fuel system — Select.
 - c. If operation on the emergency fuel system is satisfactory, land as soon as practical.

Do not switch back to normal fuel system.
2. If throttle cannot be moved, or the emergency fuel system has been selected and RPM still fails to respond to throttle manipulation, accomplish the following as applicable.
 - a. RPM too low to sustain level flight at safe altitude (below approximately 85 percent at low altitude, clean aircraft) follow forced landing procedure, or eject. If forced landing is elected, pattern may be larger than normal, depending on RPM (see forced landing and ejection decision factors and precautionary landing).
 - b. RPM above 85 percent. Use speed brakes and maneuvering (pulling G) to reduce speed below landing gear and flap extension speed. Extend landing gear and flaps. Continue to maneuver so that runway threshold is reached at reasonable speed.

Note

Pilot judgment will determine the amount of "G" and maneuvering necessary, depending upon the thrust output of the engine.

- c. If it is necessary to flame-out the engine to eliminate excessive thrust, this can be accomplished by turning the fuel tank selector OFF [997C and 1044] N/C/W, fuel shutoff switch SHUTOFF [997C or 1044] C/W, when certain the runway can be reached (depending on RPM, airspeed, altitude and distance). If the pilot elects to flame-out the engine, proceed as follows:

- (1) RAT — Extend.

- (2) Fuel tank selector — OFF [997C and 1044] N/C/W.
- (3) Fuel shutoff switch — SHUTOFF [997C or 1044] C/W.

Note

If RPM is full military when the fuel tank selector is turned OFF [997C and 1044] N/C/W, fuel shutoff switch positioned to SHUTOFF [997C or 1044] C/W the engine will flameout and thrust will be lost immediately. If RPM is less than full military flameout and thrust loss will be slightly delayed.

- (4) Speed brake switch — As required, then HOLD.

The HOLD position will retain the speed brakes in the selected position after the engine flames out. The IN or OUT position will permit the speed brakes to assume a streamlined position.

- (5) (a) When on the ground — Emergency brake — Pull.

Only three full brake applications are available. Each reduction in pressure bleeds off the total amount of hydraulic fluid available.

- (b) Be prepared to engage the barrier.

3. If engine flames out inadvertently.

- a. RAT — EXTEND immediately.
 - b. Follow forced landing procedure or eject.
- (See forced landing and ejection decision factors.)

OIL SYSTEM FAILURES.

If an oil system malfunction (caused by low oil pressure or excessively low oil quantity) has caused prolonged oil starvation of engine bearings, the result will be a progressive bearing failure and subsequent engine seizure. This progression of bearing failure starts slowly and will normally continue at a slow rate up to a certain point at which the progression of failure accelerates rapidly to complete bearing failure. The time interval from the moment of oil starvation to complete failure depends on such

factors as: condition of the bearings prior to oil starvation, operating temperatures of bearings, and bearing loads. Bearing failure due to oil starvation is generally characterized by a rapidly increasing vibration; when the vibration becomes moderate to heavy, complete failure is only seconds away, and, in most instances, the pilot will increase his chances of a successful ejection or power-off landing by shutting down the engine. Engine operation is possible for a limited time at reduced thrust with little or no oil pressure. Engine operation for more than a few seconds at high thrust with little or no oil pressure, however, is extremely hazardous and may cause engine seizure or turbine shaft failure and therefore, turbine overspeed and disintegration. Since the end result of oil starvation is engine seizure, the following instructions should be observed in an attempt to forestall engine seizure as long as possible.

OIL PRESSURE FLUCTUATION IN EXCESS OF 5 PSI.

Oil pressure fluctuations within 5 PSI in the normal range are considered normal. The fluctuation tolerances depend on the setting of the oil boost pump pressure relief valve adjustment. High or low absolute oil pressure readings are more significant in detecting oil system malfunctions rather than oil pressure fluctuations. When excessive oil pressure fluctuations occur, the system is not operating correctly.

1. Monitor oil pressure and land as soon as practical.

OIL PRESSURE BETWEEN 35 AND 40 PSI.

1. Reduce RPM.
2. Monitor oil pressure gages closely.
3. Land as soon as practical

OIL PRESSURE BELOW 35 PSI.

The oil low pressure caution light will illuminate between 39 and 23 PSI as pressure decreases.

1. Reduce RPM to minimum necessary for safe level flight and approach maneuvers.

2. HYD UT/OIL PRESS fuse — Check.

Observe utility hydraulic pressure gage and crack speed brakes. If indication on utility hydraulic gage fluctuates, HYD UT/OIL PRESS fuse is good.

3. External stores — Jettison as required.
4. Minimize G forces.

Avoid all abrupt maneuvers which cause high G forces.

5. Avoid unnecessary throttle movements.

Place throttle at minimum practical RPM setting, and avoid further throttle movements as much as possible. Any necessary thrust adjustments should be made by slow, cautious movements. If a high thrust setting is required, select minimum RPM in Extend A/B Range rather than a higher RPM setting. This will reduce engine temperatures and pressures, and will result in longer engine operation than will the use of a higher RPM.

6. Land as soon as possible, using precautionary landing pattern or simulated flame-out pattern.

WARNING

If smoke is noticed in exhaust, or if moderate-to-heavy vibration occurs, engine should be immediately shutdown to improve chance of successful ejection or flame-out landing.

OIL PRESSURE ABOVE 50 PSI.

Continuous high oil pressure indications are very unlikely. High oil pressure (up to 80 PSI maximum) is acceptable for short periods, such as takeoff and climb. The oil pressure increase is due to cold oil bypassing the fuel oil cooler. Oil pressure above the normal operating limits is not acceptable during continuous or stabilized engine operation. When oil pressure is excessive, the system is not operating correctly and should be corrected before the next flight.

1. Monitor oil pressure and land as soon as possible.

ENGINE DUCT INSTABILITY. (VAI System Failure)

SUPERSONIC FLIGHT.

At supersonic speeds engine duct instability (duct buzz) may occur if duct airflow is not the correct value needed to satisfy engine air inlet requirements. This condition is a result of the duct plugs, or bleed door, not being compatible with engine air requirements for a given combination of airspeed, altitude, and air density. Such a condition is a possible result of a failure in either the central air data computer, or the variable air inlet computer. To prevent or stop buzz proceed as follows:

1. Airspeed — Reduce to subsonic quickly.
 - a. Throttle — Inboard.
 - b. Speed brake switch — OUT.
 - c. Establish a climb attitude or pull G.

WARNING

Duct buzz is flow instability in the duct and should not be prolonged. Do not retard throttle as duct buzz may be aggravated.

2. *If duct buzz continues*, VAI switch — EMERG.

Switch may be placed in EMERG during supersonic flight.

3. VAI switch — CRUISE at Mach 1.3 or below.

If the VAI switch is placed in EMERG, select the CRUISE position and observe that the plugs move full aft. Observe speed restrictions with VAI system inoperative presented in figure 5-4 in section V.

SUBSONIC FLIGHT.

In some rare types of failures of the VAI system at subsonic speeds, the plugs and bleed doors may begin to move below the prescribed cut-in Mach NO. If this occurs, it will result in loss of thrust possibly accompanied by loud bangs and/or engine compressor stalls or surges. Proceed as follows:

1. VAI switch — EMERG, then CRUISE if in AUTO.
2. Reduce speed to landing gear extension speed.
3. Landing gear handle — DOWN.
4. Prepare to land as soon as possible.

Note

If it is impossible to return the duct plugs to the subsonic configuration (full aft) approximately 12 percent thrust loss in MILITARY will result. However, a go-around may still be accomplished if required.

FUEL SYSTEM FAILURES.

FUEL INLET PRESS LIGHT AND NO BOOST PUMP LIGHTS.

The fuel pressure downstream of the fuel shutoff valve has dropped below 1 PSI as a result of a malfunctioned fuel shutoff valve or otherwise obstructed main fuel line and *engine flame-out is probable*. When engine flame-out is preceded by this light alone, air start will be improbable. See factors affecting Air Start, Forced Landing and Ejection in this section.

1. Throttle — Inboard and retard.
2. Fuel tank selector — Check position.
3. Monitor fuel flow indicator for impending flame-out.
4. If engine flames out — Attempt air start, make forced landing or eject.

FUEL INLET PRESS AND MAIN BOOST PUMP LIGHTS, AND FORWARD AND/OR AFT TANK CONTAIN FUEL.

(Main boost pump inoperative and by-pass valve failed to transfer.)

Under this condition, the forward and aft boost pumps will continue to transfer fuel to the main tank from which it will gravity feed to the engine. All fuel will be recovered.

MAIN BOOST PUMP LIGHT.

(Main tank boost pump inoperative.)

Reduced pressure at the main tank pump outlet permits a spring loaded by-pass valve to open a port which lets the forward and aft tank boost pumps pump fuel directly to the engine. When the forward and aft tanks are empty, the main tank fuel will gravity flow to the engine. All fuel will be recovered.

FWD BOOST PUMP LIGHT.

(Forward tank boost pump inoperative.)

The forward tank will discontinue transferring fuel to the main tank. (On [E] aircraft the CG pump will continue to transfer fuel to the main tank if the forward tank is above approximately 1390 pounds the forward boost pump switch is in the FWD/CG position and AC secondary power is available. When fuel remaining in the forward tank drops to 1390 pounds the CG pump will shut off. When the aft and main tanks are empty the forward tank will gravity flow

to the engine. If the aft tank boost pump switch is positioned to OFF for CG control, the main tank will empty first, then both the forward and aft tanks will gravity flow to the engine.

AFT BOOST PUMP Light.

(One or both aft tank boost pumps inoperative.)

If one aft tank boost pump is inoperative the aft tank will continue to transfer fuel to the main tank, but at a reduced rate. If both aft tank boost pumps are inoperative the aft tank will discontinue transferring fuel to the main tank. If the forward (CG) tank boost pump switch is positioned to OFF and fuel continues to transfer from the aft to the main tank, one aft tank boost pump is operating. If fuel does not transfer from the aft tank to the main tank, both aft tank boost pumps have failed. In this case the main tank will empty first, then both the forward and aft tanks will gravity feed to the engine. Proceed as follows:

1. ☐ Forward boost pump switch — OFF.
☐ Forward/CG pump switch — OFF.
2. Monitor individual fuel tank quantities to determine single or dual aft boost pump failure.

If one pump is operating it will continue to transfer fuel from the aft tank to the main tank.

3. a. *If single pump failure*, forward boost pump switch — ON or OFF as required for CG control.
- b. *If dual pump failure:*
 - (1) Forward boost pump switch — OFF.
 - (2) When main tank empties — Follow Gravity Fuel Feed Procedure.
 - (3) For landing — Forward boost pump switch — ON.
 - (4) (a) *If main tank fills to 1100 pounds*, make normal landing.
 - (b) *If main tank is below 1100 pounds*, make landing with Gravity Fuel Feed.

GRAVITY FUEL FEED PROCEDURE.

Any circumstance that requires gravity fuel feed to the engine requires that a landing be made as soon as practical preferably before the aft tank becomes the sole source of fuel. Gravity feed will not take

place while any tank containing fuel has a boost pump operating. Failures that involve loss of AC electrical power will result in immediate gravity feed. A dual aft tank boost pump failure requires turning the forward tank boost pump off. This will result in the main tank emptying first, then the forward and aft tanks gravity feeding.

1. Establish altitude predicated on range requirements and airspeed for optimum cruise.
2. Monitor internal fuel distribution and flow to engine.
3. Auxiliary fuel — Transfer as required.
4. External stores — Jettison as required.
5. Land as soon as practical using procedure for landing with Gravity Fuel Feed.

EXCESSIVE FUEL CONSUMPTION/LOSS OF FUEL.

If abnormal fuel consumption is noted, especially after A/B shutdown it may be due to failure of the afterburner fuel regulator valve seat. When the throttle is moved to the outboard position, the surge of fuel through the afterburner regulator would tend to dislodge any foreign material from the orifices located behind the afterburner shutoff valve. When these passages are cleared, the fluid flow will improve and allow the shutoff valve to operate freely. The return of the throttle to the inboard and aft position allows the shutoff valve to seat. The amount of fuel consumption due to a failed regulator shutoff valve will vary depending on the degree of failure. Because of the high consumption rates that may be experienced, it is imperative that immediate action be taken to select a landing site and land as soon as possible. After any inflight afterburner operation monitor total fuel quantity for a period of time for indications of excessive fuel consumption. If excessive fuel consumption is noted, proceed as follows:

1. Throttle — Check inboard.
2. Throttle — IDLE if fuel consumption remains excessive. This assures A/B cutoff.
3. Throttle — Advance to cruise RPM.
4. Check for possible fuel venting.
5. If excessive fuel loss continues, proceed as follows:
 - a. Throttle — Outboard to ignite A/B for 2 seconds.

b. Throttle — Inboard and to IDLE for 2 seconds.

c. Throttle — Advance to cruise RPM.

6. Fuel consumption — Check.

- a. If fuel consumption remains excessive — Land as soon as possible (afterburner fuel regulator shutoff valve failure indicated).
- b. If fuel consumption is normal — Determine range by fuel available.

EXCESSIVE FUEL VENTING

Excessive fuel venting from the internal fuel tanks may be caused by the following:

- Failure of the dive vent ram shutoff valve or pressure switch in the open position, or leaving the fuel tank selector positioned to an empty tank when the climb vent ports are submerged as a result of nose down attitude or deceleration.
- Failure of the dual level control valve in the main tank to close. This valve controls internal fuel transfer.
- Failure of one of the three individual tanks shutoff valves to close. These valves control auxiliary fuel transfer and refueling.

In all cases of internal venting the aft tank will be full and fuel venting can be stopped by maintaining the aft tank level below 2500 pounds.

Excessive fuel venting from auxiliary fuel tanks may be caused by:

- Failure of a shutoff valve.
- Expansion of trapped air.

Fuel venting is of concern to the pilot for two reasons:

1. Continuous venting can result in the loss of large quantities of fuel.
2. Recent tests have shown that on unmodified aircraft fuel vented overboard may, under flight conditions, re-enter the aft section and become a fire hazard.

Note

Intermittent slugs of fuel may escape through the vent system as a result of acceleration, deceleration, or expansion of trapped air when the vent port is covered with fuel.

All aircraft incorporate an excessive fuel venting indicating system that alerts the pilot when internal fuel venting is excessive. A longer sabre drain prevents vented fuel from re-entering the aft section. The internal fuel tanks, bomb bay and centerline tanks are all vented through the longer sabre drain. The bomb bay tank vent line incorporates a solenoid shutoff valve that closes when the tank fuel level approaches the vent outlet. On [F] aircraft the CG pump is controlled by the FWD/CG pump switch.

Fuel Venting From Either Wing Overboard Outlet.

(Wing pylon fuel tank venting.)

Wing pylon tanks (on modified and unmodified aircraft) are vented independently through outlets in the bottom of the wing immediately outboard of the respective pylons.

1. Fuel tank selector switch — EXT WG TK (WING).
2. If necessary other auxiliary tanks may be selected. Monitor malfunctioned tank as it will refill. Prior to overfilling, terminate auxiliary fuel transfer and repeat step 1 as necessary.

Note

During air refueling venting may resume. Monitor fuel quantity to prevent overfilling and resumption of venting.

Loss of Fuel — Fuel Leak Caution Light Not Illuminated [1061] C/W.

If a loss of fuel is suspected due to damage in the fuel system not protected by the fuel leak sensing system, auxiliary fuel transfer should be terminated and the aircraft landed as soon as possible. This loss can be detected by a rapid decrease in the fuel quantity in the damaged tank. If auxiliary fuel is required before a landing can be made, auxiliary fuel transfer can be utilized as required but should not remain on after an internal tank is full. During transfer the fuel transferred to the damaged tank will be lost.

1. Fuel tank selector — MAIN TK (MAIN).
2. Land as soon as possible.
3. If auxiliary fuel is required, fuel tank selector — Position to auxiliary tank with fuel until sufficient fuel is transferred but return to MAIN TK (MAIN) after forward or aft tank is full.
4. Utilize air refueling only if necessary as fuel will be lost through the damaged fuel system during the refueling cycle.

Fuel Leak Caution Light Illuminated [1061] C/W.

Illumination of the fuel leak caution light, when the alternate engine fuel feed switch is in the AUTO-MATIC position, indicates that a fuel leak has been detected, the main tank transfer line shutoff valve will close, automatic bomb bay fuel feed circuit is deactivated, the fuel purging valve is closed, and on ☐ aircraft the forward CG pump circuit is deactivated. Auxiliary fuel transfer should be terminated and the aircraft landed as soon as possible. If fuel in the auxiliary tanks is required before a landing can be made, auxiliary fuel transfer can be utilized as required but should not remain on after an internal tank is full. During transfer the fuel transferred to the main tank will be lost.

1. Fuel tank selector — MAIN TK (MAIN).
2. Land as soon as practical. (If battle damage is suspected, land as soon as possible.)
3. If auxiliary fuel is required, fuel tank selector — Position to auxiliary tank with fuel until sufficient fuel is transferred but return to MAIN TK (MAIN) after forward or aft tank is full.
4. In the event of a flameout which could only be caused by a second failure, during operation with the fuel leak caution light illuminated: Alternate engine fuel feed switch — DEACTIVATE and attempt an air start.
5. If the fuel inlet pressure caution light illuminates, which could only be caused by a second failure, during operation with the fuel leak caution light illuminated: Alternate engine fuel feed switch — DEACTIVATE.
6. Utilize air refueling only if necessary as fuel will be lost through the damaged fuel system during the refueling cycle.

FUEL LEAK CAUTION LIGHT ILLUMINATED [1061] C/W. (No Evidence of Fuel Leakage)

If the FUEL LEAK light illuminates for no apparent reason (the aircraft is not in a combat area, there is no evidence of fuel leakage from the bomb bay or engine areas, or there is no other unexplained fuel loss) a Leak Detection System malfunction is likely. Proceed as follows:

1. Fuel tank selector — MAIN TK.
2. Alternate Engine Fuel Feed Switch — Check, AUTOMATIC.
3. Monitor FIRE warning light.
4. Monitor Main Tank fuel quantity.
5. Check for evidence of excessive fuel consumption or loss of fuel. Have other aircraft check for indications of fuel leakage from the bombbay or engine compartment areas.
6. Alternate Engine Fuel Feed Switch — DEACTIVATE. Disregard FUEL LEAK CAUTION light while switch is selected to DEACTIVATE.
7. Aux Fuel — Transfer as required.
8. Air refueling — As required.

Air Refueling Without Utility Hydraulic Pressure.

In the event of utility hydraulic pressure is not available the probe can still be extended. When the air refuel handle is actuated a spring will extend the probe sufficiently to permit ram air pressure to extend the probe all the way. After refueling the probe cannot be retracted, however, the handle must be pushed in to permit transfer of auxiliary fuel.

Note

Provisions are included to permit air refueling after a loss of utility hydraulic pressure. A tension spring, attached to the slipway door, and ram air pressure will open the door. The latches will not be actuated, therefore it will be necessary to maintain relative aircraft position to keep the boom nozzle and receptacle engaged. The ready light will remain illuminated and the amplifier will not be activated to signal the tanker to initiate and terminate the refueling operation. Communication between the tanker and receiver will be required to coordinate refueling.

Recovery of Auxiliary Fuel With AR Probe Extended or Slipway Door Open.

In the event the AR probe or door is damaged during air-refueling, and the pilot deems it unsafe to retract the probe or close door because of possible foreign object damage to the engine, the following procedure is recommended to transfer auxiliary fuel.

1. AIR REFUEL circuit breaker — Pull [997C and 1044] N/C/W.
2. REFUEL circuit breaker — Pull [997C or 1044] C/W.

CAUTION

The extended air refueling probe will reduce range approximately 15 percent. Observe airspeed limitations for extended refueling probe in section V.

Failure of External Fuel Tanks to Feed.

Failure of the external fuel tanks to feed can be caused by an electrical short which causes the FUEL SYS [997C and 1044] N/C/W, FUEL TRANSFER [997C or 1044] C/W circuit breaker to disengage or failure of the air refueling relay to de-energize which will not allow the external tank vent valves to close. If external fuel tanks fail to feed, proceed as follows:

1. FUEL SYS circuit breaker — Check [997C and 1044] N/C/W.

FUEL TRANSFER circuit breaker — Check [997C or 1044] C/W.

- a. If circuit breaker is disengaged, re-engage. If circuit breaker again disengages, select a different position on the fuel tank selector and re-engage the circuit breaker.
- b. If circuit breaker is engaged, cycle the air refueling handle.
- c. If problem still exists:

AIR REFUEL circuit breaker — Pull [997C and 1044] N/C/W.

REFUEL circuit breaker — Pull [997C or 1044] C/W.

Inflight Damage to Fuel System Sabre Drain.

If sabre drain damage occurs, negative pressures may be formed in the internal fuel cells. Such a pressure can cause the fuel cells to collapse which normally results in fuel being vented overboard and/or a rapid increase in total fuel quantity indication. It is impossible for the pilot to know how much fuel remains. The uncertain fuel quantity necessitates that a landing be made before all fuel is expended. If inflight damage to the fuel system sabre drain is noted, proceed as follows:

1. Land as soon as possible.

CAUTION

Disregard fuel quantity gage and fuel low caution light indications as they are not accurate under conditions of sabre drain damage.

Excessive Fuel Venting During Air Refueling.

Malfunction of the bomb bay float level switch has resulted in over pressurization and/a tank rupture. This possibility has been lessened by reducing the flow rate on the last 1000 pounds of fuel needed to complete air refueling. Indications of a malfunction may be preceded by abnormal and/or excessive fuel venting from the sabre drain. When abnormal and/or excessive fuel venting occurs during a refueling, proceed as follows:

1. Discontinue refueling.
2. Porpoise aircraft a number of times in an attempt to dislodge a stuck float switch.
3. Engage and complete refueling.
4. If fuel venting is still present on re-engagement, disengage and repeat steps 2 and 3 or abort flight as applicable.

FUEL LOW CAUTION LIGHT ILLUMINATED.

(Main tank fuel level is 1000 ($\pm$ 200) pounds remaining.)

When the FUEL LOW light illuminates steadily while the forward and/or aft tanks contain fuel and their boost pumps are operative, internal fuel transfer to the main tank has been interrupted. This will occur if the Fuel Level Control Valve, located in the main tank, becomes stuck in the closed position or if the Transfer Shutoff Valve closes. Main tank fuel will continue to be pumped to the engine until this tank is empty. Forward and/or aft tank fuel will then be pumped to the engine through the bypass valve. External fuel should be transferred to the internal tanks. If external transfer is available and selected, the main tank may fill sufficiently for the FUEL LOW light to go out, but if the problem persists it will illuminate again. All fuel will be recovered and will be pressure fed to the engine.

PROCEED AS FOLLOWS:

1. Check Main Tank quantity.
2. Check forward and aft tank quantities.
3. Forward/AFT/F CG Boost Pump Switches — Check, ON.
4. Alternate engine fuel feed switch — DEACTIVATE. If main tank quantity does not increase: Alternate engine fuel feed switch — AUTOMATIC (1061 C/W).
5. Aux fuel — Transfer as required.
6. Air refueling — As required.
7. Land as soon as practical. If the aft tank becomes the only source of fuel, avoid decelerations or nose down attitudes which might uncover the aft tank fuel ports.

ELECTRICAL POWER SYSTEM FAILURES.

Note

For essential equipment that will be inoperative in the event of electrical failure, see figure 3-8.

DC GEN LIGHT.

(DC generator inoperative.)

With the DC generator inoperative, equipment powered by DC secondary power will be inoperative and equipment powered by DC primary power will be operated by the battery. The battery is capable of operating all primary powered equipment for a limited time. Therefore, if the DC generator cannot be reset, subsequent procedures will depend upon the duration of flight before a landing can be made. Proceed as follows in accordance with anticipated remaining flight time.

1. Unnecessary DC electrical equipment switches — OFF.

Turn off all electrical equipment that is not essential to maintain flight.

2. DC generator switch — RESET, then ON.

If generator was disconnected because of voltage variations, placing the DC generator switch to RESET momentarily, and then to ON, will reset the generator field control relay, and the generator will be operative again. Several attempts to reset the generator may be made.

3. If generator does not operate — DC generator switch — OFF.

ELECTRICAL POWER SUPPLY SYSTEM

failure chart

NOTE

This table is limited to essential controls and equipment.

NOTE

Electric power failure only, utility hydraulic pressure available.

This table is limited to essential controls and equipment.

Electric power failure only, utilizing hydraulic pressure available.

ESSENTIAL CONTROLS OR EQUIPMENT	AC GEN	AC GEN AND INVT	DC GEN	AC AND DC GENERATOR FAILURE
ARRESTING HOOK JETT EXT STORES (F) BAIL OUT LIGHT VAI SYSTEM A/B STARTING AILERON LOCKOUT AIR START AUX FUEL TRANSFER CANOPY ELECT OPER COMMAND RADIO EMER FUEL SYST SW FUEL TANK SEL IFF/SIF LE & TE FLAPS LG IND & WARN PITCH MA SHIFTER SPEED BRAKES RATE OF TURN (ADI) FLAP POSITION IND (F) TAKE-OVER BUTTONS (FLIGHT, COMM, NAV, WEAPONS)	ONLY EMERG AND CRUISE AVAILABLE			POWER AVAILABLE POWER AVAILABLE WITH BATTERY SWITCH "ON"
(F) TAKE-OVER BUTTONS (TACAN & RADAR)				INOPERATIVE
ADI & HSI (F) EGT GAGE FUEL FLOW IND FUEL QUANTITY IND HYD PRESS GAGE OIL PRESS GAGE STBY ATTITUDE IND	POWER AVAILABLE WITH BATTERY SWITCH "ON" AND INVERTER SWITCH AT "STANDBY"	INDICATORS WILL TEND TO INDICATE LAST READING PRIOR TO FAILURE	POWER AVAILABLE	POWER AVAILABLE WITH BATTERY SWITCH "ON" AND INVERTER SWITCH AT "STANDBY"
AMI & AVVI FUEL BOOST PUMPS PRESS RATIO GAGE TACAN	INOPERATIVE			INOPERATIVE
(D) EGT GAGE TACHOMETER	INDEPENDENT OF AIRCRAFT ELECTRICAL SYSTEM			
CANOPY JETTISON LDG OPERATION	NO ELECTRIC POWER REQUIRED			

Figure 3-7

4. Land as soon as practical.
5. a. If flight time will not exceed 1 hour, battery switch — ON.
- b. If flight time will exceed 1 hour, but less than 2 hours:
 - (1) Battery switch — ON.
 - (2) CIN PWR (ELECT SYS CNTRL PWR) circuit breaker — Pull.

Note

The circuit breaker must be reset for command radio or IFF/SIF operation. Approximately 90 seconds warm-up time is required before this equipment will operate.

- c. If flight time will exceed 2 hours, battery switch — OFF.

Note

Battery switch must be ON for command radio or IFF/SIF operation. When the battery switch is repositioned to ON, the ATM will automatically shutoff and require restarting.

- Fire and overheat warning lights will be inoperative with the battery switch OFF.
6. At least 10 minutes prior to entering traffic pattern, perform the following, as necessary:
 - a. Hold ATM switch to START while placing battery switch ON.
 - b. CIN PWR (ELECT SYS CNTRL PWR) circuit breaker — Reset.

Note

Approximately 90 seconds warmup time will be required before the command radio or IFF/SIF will be operative after power is restored.

7. Make a normal landing, be prepared for a greater than normal sink rate if throttle is moved to IDLE.

With the DC generator inoperative, landing gear handle down and throttle moved to IDLE, thrust decay will operate in the air.

DC AND AC GENERATOR INOPERATIVE.

In the event both the DC and AC generator are inoperative and cannot be restarted the aircraft must be operated with the battery as the only source of electrical power. A fully charged battery will satisfy the minimum electrical requirements with the standby inverter operating for approximately 0.6 hours on [F] aircraft and 0.9 hours on [D] aircraft. If the aircraft must be airborne for more than 30 minutes the battery must be conserved for essential communication, transferring auxiliary fuel, and the landing procedure. If a primary DC power interruption occurs while secondary AC power is off, on aircraft with PP-1851 power supplies below S/N220 or not marked Mod E, the entire CIN system will be inoperative. If only DC power is returned the CIN system will still be inoperative and the CIN power caution light will illuminate. The CIN system can again be activated only when secondary AC and primary DC power are available to the power supply.

1. Use standby airspeed indicator and altimeter.
2. All unnecessary electrical equipment switches — OFF.
3. Follow Gravity Fuel Feed Procedure.
4. a. If flight time will not exceed 30 minutes, battery switch — ON.
- b. If flight time will exceed 30 minutes:
 - (1) Battery switch — OFF.
 - (2) Inverter switch — OFF.
 - (3) CIN PWR (ELECT SYS CNTRL PWR) circuit breaker — Pull.

Note

For command radio, on aircraft with a modified power supply (above S/N220 or marked Mod E), the battery must be ON and the CIN PWR (ELECT SYS CNTRL PWR) circuit breaker IN. A 25 to 35 second warmup period must be completed before radio transmission can be resumed with modified power supply.

- To transfer auxiliary fuel the battery switch must be ON.
 - To read fuel quantity, oil pressure, hydraulic pressure, etc., the battery must be ON and the inverter in STANDBY.
5. Follow procedure for landing with Gravity Fuel Feed.
 6. Ten minutes prior to entering traffic pattern:
 - a. Battery switch — ON.
 - b. Inverter switch — STANDBY.
 - c. CIN PWR (ELECT SYS CNTRL PWR) circuit breaker — Reset.

BATTERY HIGH CHARGE AND/OR BATTERY HIGH VOLTAGE CAUTION LIGHT ILLUMINATED [955] C/W.

Illumination of the battery high charge and/or high voltage caution lights indicate a condition which could cause battery damage or failure. Turning the battery switch off will disconnect the battery from the DC generator system thereby protecting the battery. Operation of all systems will be normal provided the DC generator remains operational.

1. Battery switch — OFF.

If DC generator is operating (DC GEN light not illuminated) continue flight and land as soon as practical.

Note

With battery switch OFF, DC power for arresting hook extension, operation of the bailout lights, operation of the canopy actuator and the landing gear downlock override switch will be dependent on the condition of the battery since these circuits are powered by battery power only.

If DC generator is inoperative, proceed as follows:

2. Unnecessary DC electrical equipment — OFF.
Turn off all electrical equipment that is not essential to maintain flight.
3. Land as soon as practical.
4. Battery switch — ON intermittently as necessary for communications and just prior to landing.

Note

If the DC generator fails, subsequent to turning the battery switch OFF, because of a high charge and/or high voltage light, duration of the battery will depend on its condition at the time of turning the battery switch OFF. Each use of the battery will reduce its total operating time.

ATM FAILURE (AC GENERATOR/ATM INOPERATIVE) [1049] N/C/W.

With the inverter switch in STANDBY, place a demand on the utility hydraulic system and observe utility hydraulic gage.

- If utility hydraulic pressure is maintained — The AC generator alone is inoperative.
- If utility hydraulic pressure is dissipated — Both the AC generator and the ATM are inoperative.

With the AC generator inoperative all fuel boost pumps will become inoperative and fuel will gravity flow to the engine. See figure 3-8 for other systems affected by an inoperative AC generator.

If the ATM has failed, both the AC generator and the utility hydraulic system will be inoperative and those systems actuated by utility hydraulic pressure will be inoperative. Afterburner operation may not be possible because the speed brakes may not open or hold in the afterburner position. If ATM failure occurs while the afterburner is operating, it will continue to operate, even if the speed brakes do not remain in the afterburner position, until shutdown normally or mechanically by the pilot.

1. If ATM is inoperative, ATM switch — Hold to START until utility hydraulic pressure stabilizes.
If ATM will not start, or there is smoke, fire or explosion in ATM compartment — Hold to STOP.
2. If ATM is operating, AC generator switch — RESET, then ON.
3. If ATM or AC generator cannot be started, follow Gravity Fuel Feed Procedure for cruise and descent and follow procedures for landing with "Gravity Fuel Feed" and "Utility Hydraulic System Inoperative" if applicable.
4. Land as soon as practicable.

UTILITY HYDRAULIC SYSTEM FAILURE.

When the utility hydraulic system fails, those systems actuated by utility hydraulic pressure will be inoperative. In the event of utility system failure, afterburner operation may not open or hold in the afterburner position. If utility system failure occurs while the afterburner is operating, it will continue to operate, even if the speed brakes do not remain in the afterburner position, until shutdown normally or mechanically by the pilot. Follow Landing With Utility Hydraulic System Inoperative Procedure.

FLIGHT CONTROL HYDRAULIC SYSTEM FAILURES.**SINGLE PRIMARY HYDRAULIC SYSTEM FAILURE.**

If either primary one or primary two hydraulic system fails the remaining operating system will actuate the flight controls. With single pump operation maneuverability will be restricted to the extent that the actuators can support $\frac{1}{2}$ of the maximum hinge moment. In the event the primary one or primary two hydraulic pressure gage indicates an abnormal pressure reduction or excessive fluctuation, proceed as follows:

1. Do not extend RAT.

WARNING

In the event of the failure of the primary one hydraulic system, the ram-air turbine should not be extended as pump failure cannot generally be differentiated from failure due to fluid loss. In the latter case, using the emergency hydraulic system will deplete the fluid supply for the utility hydraulic system.

- In the event of failure of the primary two hydraulic system, extension of the ram-air turbine would switch the primary one system which is operating normally.
2. AFCS emergency disconnect lever — Actuate.

Actuating the AFCS emergency disconnect lever assures AFCS disengagement and isolation of all AFCS hydraulic compartments.

3. Avoid rapid stick motion and land as soon as practical.

Rapid stick motion or stick pumping could result in a restrictive feel to the stick.

4. Monitor operating system, be alert for failure.

BOTH PRIMARY HYDRAULIC SYSTEMS FAILURE [1049] N/C/W.

In the event both primary one and primary two hydraulic systems fail the RAT must be extended and flight control provided by the emergency hydraulic system. The emergency hydraulic system utilizes the fluid supply of the utility hydraulic system, pressurizes it and provides it to the primary one hydraulic system. The RAT will provide adequate hydraulic power for flight control down to approximately 70 KCAS.

1. RAT lever — EXTEND (observe RAT extension limits).

Move forcefully to the full forward position with no hesitation in the mid travel area. If possible do not move controls during RAT lever movement. Engine chugging or mild stalls may be experienced with the RAT extended.

2. AFCS emergency disconnect lever — Actuate.

Actuating the AFCS emergency disconnect lever assures AFCS disengagement and isolation of all AFCS hydraulic components.

3. Avoid rapid stick motion and land as soon as possible.

Rapid stick motion or stick pumping could result in a restrictive feel to the stick.

4. If engine chugging or partial compressor stall occurs — Change altitude or airspeed.

FLIGHT CONTROL HYDRAULIC SYSTEM DAMAGE. (PILOT RECOVERY) [1045] C/W.**Operational Emergency [1045] C/W.**

With impending loss of flight control hydraulic power, as evidenced by fluctuation or fall off of pressure indication due to system damage, the following procedure is recommended:

1. Bring aircraft to a 10 to 15 degree nose up attitude.
2. External load — Jettison.
3. Stabilizer lock switch — LOCK.

4. Move the control stick fore and/or aft to engage the stabilizer lock. After engagement the stick will be locked in approximately neutral position.

WARNING

Do not delay engagement of the stabilizer lock unnecessarily as the actuator must be moved to the locked position with hydraulic pressure for the lock to engage.

- If lock is engaged above the specified speed range the aircraft must be in a 10 to 15 degree nose up attitude and the speed reduced as quickly as possible to the recommended values.
 - Do not exceed 0.85 Mach with lock engaged since flight characteristics of the aircraft are such that the speed will then steadily increase in a nose down attitude though corrective nose up control (increased power and reduced flap deflection) is used.
5. Maintain speed range from 350 KIAS to 0.85 Mach number up to 20,000 foot altitude.
 6. Maintain flight by coordinating engine thrust, symmetrical and/or differential trailing edge flaps with the emergency pitch and roll control switches and unboosted rudder. Limit flap extension to 30%.
 - Retract flaps. (Pitch control switch aft.)
 - Nose down — Decrease thrust.
Extend flaps. (Pitch control switch forward.)
 - Bank and turn — Use rudder supplemented with minimized use of roll control switch as required.
 - Roll trim — Use emergency roll control switch (differential flaps).

WARNING

Do not attempt to land with the stabilizer locked.

7. If normal flight control is determined to be available and the emergency flight control system is no longer required:

- a. Put slight forward pressure on the control stick and hold until the forward lock is felt.
- b. Stabilizer lock switch — NORM.
- c. After at least 2 seconds apply back pressure on control stick. Lock will release.

Note

Stabilizer lock light will dim momentarily then go out when returning the stabilizer lock switch from LOCK to NORM position.

Training Mission [1045] C/W.

When the emergency flight control system is utilized under properly authorized conditions for training missions *use of the stabilizer lock is prohibited*. This can be accomplished by inserting the stabilizer lock safety locking pin and disconnecting the electrical plug at the actuator.

All training flights should be conducted in the clean (no external load) configuration.

1. Trim aircraft hands off at 350 KIAS and 10,000 feet altitude.
2. Stab-aug button — OFF.
3. Pitch MA switch — OFF.
4. Stabilizer lock switch — LOCK.
5. Leave control stick in its trimmed position.
6. Maintain flight by coordinating engine thrust, symmetrical and/or differential trailing edge flaps with the emergency pitch and roll switches and rudder. Limit flap extension to 30%.
 - Nose up — Increase thrust.
Retract flaps. (Pitch control switch aft.)
 - Nose down — Decrease thrust.
Extend flaps. (Pitch control switch forward.)
 - Bank and turn — Use rudder (in an actual control system loss only limited rudder is available due to high pedal forces about 1/6 deflection is attainable).
 - Roll trim — Use emergency roll control switch (differential flaps).

7. Disengage emergency flight control system by stabilizing speed at approximately 350 KIAS and return stabilizer lock switch to NORM position.

Note

The stabilizer lock light will go out immediately after returning the stabilizer lock switch to the NORM position.

8. Pitch MA switch — ON.
9. Stab-aug button — PUSH ON.

FLIGHT CONTROL HYDRAULIC SYSTEM DAMAGE (AIRCRAFT RECOVERY) [1049] C/W.

Operational Emergency [1049] C/W.

With immediate or impending loss of flight control hydraulic power as evidenced by fall or fluctuation of pressure indication due to system damage, the following procedure is recommended:

1. RAT—EXTEND. Check primary two hydraulic pressure gage. Move rudder pedals and control stick for roll control. Fluctuation of the hydraulic pressure gage indicates the transfer valves have actuated to direct emergency hydraulic pressure to the stabilizer, rudder and stick boost actuators.
2. External load — Jettison.
3. Flap roll control switch — CRUISE.
4. Avoid rapid stick motion. Rapid stick motion or stick pumping could result in a restrictive feel to the stick. Stabilizer will be operative with fore and aft movement of the control stick, rudder is operative with movement of the rudder pedals. Roll is accomplished using the control stick and rudder movement. Normal pitch, roll and yaw trim are available. The emergency pitch and roll switch on the right console should be used to trim the aircraft with the control stick in the neutral position.
- 5.a. Monitor primary one and two hydraulic pressure gages and if normal flight control is determined to be available from primary one system, and the emergency flight control system is no longer required:
 - (1) RAT — RETRACT.
 - (2) Continue flight, monitoring primary one and two hydraulic pressure gages.
- b. If primary one is inadequate for normal flight and the emergency hydraulic system indicated on primary two gage is determined to be inadequate for emergency flight control, the following procedure is recommended:
 - (1) Bring aircraft to a 10- to 15-degree nose up attitude.
 - (2) Stabilizer lock switch — STAB LOCK.
 - (3) Move control stick fore and aft to engage the stabilizer lock near neutral. After engagement the stick will be locked in approximately neutral position.

WARNING

Do not delay engagement of the stabilizer lock unnecessarily as hydraulic pressure is required to complete the locking action; therefore, the stabilizer must be locked before loss of the emergency flight control hydraulic pressure.

- If the lock is engaged above the specified speed range the aircraft must be in a 10 to 15 degree nose-up attitude and the speed should be reduced as quickly as possible to the recommended values.
- Do not exceed Mach 0.85 with lock engaged since flight characteristics of the aircraft are such that the speed will then steadily increase in a nose-down attitude even though corrective nose-up control (increase power and reduce flap deflection) is used.
 - (4) Maintain speed range from 350 KIAS to Mach 0.85 up to 20,000 feet altitude. Most comfortable control is achieved at 10,000 feet between 380 and 420 KIAS.
 - (5) Maintain flight by coordinating engine thrust, symmetrical or differential trailing edge flaps with the emergency pitch and roll control switch and unboosted rudder. Limit flap extension to 30%.
 - (6) Continue flight with pilot recovery system to a safe ejection area.

WARNING

Do not attempt to land the aircraft with the stabilizer locked.

Landing [1049] C/W.

Landing should be made from a long straight in approach. Have gear and flaps down prior to initiating final approach. Use extreme caution if the wind is not aligned parallel to the runway.

1. Lower flaps to approximately 50 percent. (Use emergency system switches as flap handle is inoperative.)
2. Avoid rapid stick motion. Rapid stick motion or stick pumping could result in a restricted feel to the stick.
3. Add 10 percent to recommended approach speed used for a full flap landing.
4. Establish 500 ft/min descent and hold to touchdown.
5. Minimize flare.

Leave gear and flaps down in the advent of go-around.

Training Mission [1049] C/W.

1. Slow to 300 knots at approximately 20,000 feet.
2. Extend the RAT. Note P₂ pressure approximately 3500 - 3700 psi.

Note

Engine may chug with RAT extended and power at idle. Advance the throttle to stop chugging.

3. Move normal flap lever to LANDING AND TAKE OFF position. Observe no trailing edge flap movement. Move lever back to CRUISE AND MANEUVER.
4. Extend flaps 10% by moving FLAP UP/DOWN switch (left console) to DOWN position.
5. With FLAP ROLL CONT switch in CRUISE position, move EMERGENCY PITCH AND ROLL switch (right console) to roll right. Observe that the aircraft rolls right as right

flap retracts. Position of the lower (left) flap is shown on the flap indicator. Position of the up (right) flap is shown on the flap indicator when the OTHER FLAP button is depressed.

6. Place the FLAP ROLL CONT switch to LDG R. Roll aircraft left with EMERGENCY PITCH AND ROLL switch. Observe that the left flap does not retract but rather that the right flap extends. (Flap indicator will show no movement until right flap movement equals position of left flap.)
7. Return FLAP ROLL CONT switch to CRUISE and trim the aircraft in pitch and roll using the EMERGENCY PITCH AND ROLL switch. Do not exceed 30% flaps.
8. Maneuver the aircraft with normal flight controls and normal trim buttons. (Be sure that flight controls feel normal since P₁ is operative. This would not be the case under emergency conditions and the stick would feel slightly stiff.)
9. Retract RAT. Observe both flaps come up as control is transferred back to the normal flap lever. Note normal P₂ pressure 2850 - 3150 psi.

FLIGHT CONTROL SYSTEM FAILURES.**VIBRATION OR OSCILLATIONS IN FLIGHT CONTROLS.**

(Stab-Aug or AFCS Failure)

In the event of any unusual vibration or oscillations felt in the aircraft controls, the following procedures should be utilized until control is regained, provided that safe ejection altitudes are not compromised. Since procedures cannot be established for every circumstance, pilot judgment must determine the altitude at which attempts to regain control must be abandoned. Autopilot malfunctions are the most likely cause of extraneous flight control inputs. The first three steps of the procedure eliminate all known inputs generated within the AFCS. The fourth step precludes stick-lock due to improper hydraulic transfer valve operation. The subsequent two steps are intended to eliminate all electrical inputs due to malfunctioning components, faulty wiring, or shorted connectors. Pilots should attempt to overpower high control forces as necessary to regain a safe aircraft attitude before proceeding with the following procedures. Perform as many of the following steps as necessary until the malfunction is cleared or sufficient control is gained.

1. AFCS emergency disconnect lever — Actuate.
2. Stab-aug and autopilot buttons — Check disengaged.
3. AC generator switch — OFF, trim aircraft if required.

The AC generator off assures elimination of extraneous electrical signals to the series servocylinders. If the series servocylinders fail to centerlock and move to a hard over position, the stick forces may be trimmed out with the trim switch.

4. RAT lever — Check full aft (RETRACT).
5. DC generator — OFF.
6. Battery switch — OFF.

If heavy control forces or binding persists, follow the procedures for runaway trim or an inoperative trim actuator. Under certain circumstances, it may be necessary to use some of the systems shutoff by steps 1 through 5 above. In such cases, the following troubleshooting procedure may be used.

7. Establish a safe altitude.
8. Afterburner — OFF.
9. Maintain 300 KCAS.
10. External stores — Jettison as required.
11. Proceed to confirm controllability and isolate malfunction.
 - a. Do not reengage AFCS if difficulty was cleared by step 1 or 2.
 - b. If the difficulty was cleared by accomplishing step 3:
 - (1) Do not reengage AFCS.
 - (2) AC generator — RESET, then ON, and check for recurrence of malfunction. If the malfunction persists, turn off AC generator for the remainder of flight and follow procedures for AC Generator/ATM Inoperative.
 - c. If the difficulty was cleared by accomplishing step 4:
 - (1) AC generator — RESET, then ON.
 - (2) Reengage AFCS as desired.

- d. If difficulty was cleared by accomplishing steps 5 or 6:

- (1) Stick-grip override switch — OFF.
- (2) Pitch MA switch — OFF.
- (3) Pull all circuit breakers (except the nine special weapons power circuit breakers on the left console).
- (4) Hold ATM switch to START while placing battery switch ON.
- (5) AC GEN CONTROL circuit breaker — Push in.
- (6) Reengage individual circuit breakers and switches as needed.
Leave malfunctioning circuits off.
- (7) DC generator switch — RESET, then ON.
- (8) AC generator switch — RESET, then ON.

PITCH TRIM — RUNAWAY OR INOPERATIVE.

If the pitch trim actuator fails during cruise at 35,000 feet altitude leaving a fixed trim setting, the mission could be completed with the pilot exerting between 5 pounds of push to 10 pounds of pull on the control stick at various points in the mission profile. During landing, a stick-pull force of 15 pounds is required for a normal touchdown. With a trim actuator failure, an additional pilot effort of up to 10 pounds of stick-pull is required.

1. Stick-grip override switch — OFF.
2. Stick-grip override switch — NOSE DOWN or NOSE UP as required.

WARNING

When using the stick-grip override switch for pitch trim purposes, avoid placing the switch in the NORMAL position as this will reactivate the pitch trim actuator.

Note

With the stick-grip override switch in any position other than NORMAL, the trim switch on the stick-grip will be inoperative.

3. If the stick-grip override switch is ineffective, adjust airspeed to approximately 300 KCAS, and depress the takeoff trim button and hold until the takeoff trim light illuminates.

Note

If the stick-grip override switch is ineffective, pitch trim will not be available.

PITCH MECH ADV LIGHT – ABOVE 580 KCAS.

- [D] Below 5900 feet.
- [F] Below 2400 feet

(Mechanical advantage shifter failure.)

The mechanical advantage is too low, and too much stabilizer deflection per stick movement is available. Under this condition, the pitch mechanical advan-

tage switch should be positioned to OFF to permit the pilot to evaluate his pitch control with a fixed mechanical advantage. To preclude structural damage, the aircraft should be flown with a minimum amount of pitch control applied. An oscillating mechanical advantage shifter is a malfunction that may result in pitch oscillations of the aircraft. If depressing the AFCS emergency disconnect lever does not eliminate the pitch oscillations, the pitch mechanical advantage switch should be positioned to OFF. Leave switch in the OFF position and proceed to evaluate pitch control with the fixed mechanical advantage ratio, as outlined in previous paragraphs. Normal flight, including landings, can be accomplished with any fixed mechanical advantage as long as the pilot is aware of this condition and applies pitch control movements accordingly.

1. Pitch mechanical advantage switch – OFF.

2. Reduce speed below 580 KCAS.

3. Leave pitch mechanical advantage switch OFF.

PITCH MECH ADV LIGHT – LANDING GEAR DOWN.

(Mechanical advantage shifter failure.)

The pitch mechanical advantage ratio is too high and full stabilizer travel is not available. Pitch control effectiveness will be reduced depending on the actual ratio of mechanical advantage shifter. To establish landing configuration, the pitch mechanical advantage switch should be positioned to OFF to permit the pilot to evaluate his pitch control with a fixed mechanical advantage. He may conclude that a high mechanical advantage ratio exists as indicated by excessive control stick movement required for control. For this condition a failed mechanical advantage shifter will be a factor in landing only if the aircraft is carrying nearly empty external fuel tanks. The pilot should then land with the speed brakes closed to ensure sufficient stabilizer effectiveness for the amount of stabilizer travel available.

1. Pitch mechanical advantage switch – OFF.
2. If pitch mechanical advantage caution light remains on, evaluate pitch mechanical advantage position – Land accordingly. DO NOT USE SPEED BRAKES on final approach.

WARNING

MA shifter position should be evaluated in the landing configuration at computed approach airspeeds. If the shifter failed at high airspeed, heavy forward stick pressures should be anticipated.

3. Leave pitch mechanical advantage switch OFF after landing to assist maintenance personnel.

LATERAL CONTROL – BIND.

If lateral stick-bind is encountered, proceed as follows:

1. Trim – Check for operation in direction of stick-bind.

If trim is operational, assume that icing of the artificial trim feel actuator has occurred.

Note

It is possible to obtain approximately 50 percent of full left and right stick travel by applying full trim in the direction of stick-bind and then holding the control stick in a position so as to maintain a wings-level flight condition.

2. Return to base, or suitable alternate, at cruising altitude in order to conserve fuel.
3. Descend to a lower (warmer) altitude in the vicinity of the field.
4. Remain in local area utilizing high cruise thrust settings. This will permit heat from the hot air lines in the bomb bay to assist in melting the ice.
5. Maintain pressure on the stick in the direction of bind and occasionally, bump the stick to assist in breaking it loose.
6. Make a normal landing when control stick bind is eliminated.

AILERONS – LOCKED OUT BELOW 680 KCAS.

Failure of the aileron lockout devices to return the ailerons to operation as speed is reduced to approximately 680 KCAS will cause a reduction in roll-control at lower speeds. Spoilers alone will provide sufficient control if flaps are down, at speeds low enough to permit a landing, if caution is exercised. Spoiler-control effectiveness will increase when flaps are extended. If the flaps are inoperative, control should be checked before landing.

ROLL TRIM – RUNAWAY OR INOPERATIVE.

Runaway of the lateral control trim actuator will require the pilot to hold a side stick-force of up to a maximum of 20 pounds to maintain wings-level flight. The amount of force required depends on trim requirements and direction of runaway failure.

1. Adjust airspeed to approximately 300 KCAS.
2. Stick grip override switch – OFF.
3. Takeoff trim button – Depress and hold until takeoff trim light illuminates.
4. Airspeed – As desired.

5. Use stick grip override switch for pitch trim.

WARNING

For both pitch and roll trim malfunctions, avoid returning the stick-grip override switch to NORMAL since this will reactivate the normal trim system.

RIGHT ROLL TRIM AND FEEL — INOPERATIVE.

If roll trim and feel are lost in the right roll direction but remain normal in the left roll direction proceed as follows:

1. Trim for some left roll and hold control stick against left trim as required for wings-level flight.
2. Land as soon as practical. Minimize roll stick movements by making gentle shallow turns and land from a straight in final approach.

RUDDER TRAVEL LIGHT — ABOVE 275 KCAS.

Illumination of the rudder travel caution light at speeds in excess of 275 KCAS indicates that the two-position rudder stop may have failed to restrict the rudder travel to one-quarter-full travel, and full-travel of 32 degrees right and left may be available. In this conditions, the aircraft may complete its mission and land safely. The pilot must avoid any rudder kick maneuvers, or any other maneuvers requiring more than 8 degrees right or left rudder deflection at speeds in excess of 275 KCAS.

RUDDER TRAVEL LIGHT — BELOW 260 KCAS.

Illumination of the rudder travel light below 260 KCAS indicates that the two-position rudder stop is restricting rudder travel to 8 degrees right and left and full rudder travel is not available. Crosswind landings should be avoided when in this condition. While taxiing in this condition, the maximum nose gear deflection available with nose gear steering engaged would only be 3 degrees right and left out of a normal maximum of 40 degrees right and left. It is recommended, therefore, that nose gear steering not be engaged and steering be accomplished by differential braking.

If the rudder travel caution light is illuminated with the aircraft in the landing configuration proceed as follows:

1. RUDDER CONT circuit breaker — Pull.

This may return the rudder to full travel, however, light will not go out.

YAW TRIM — RUNAWAY OR INOPERATIVE.

Runaway of the yaw trim actuator will require the pilot to hold a rudder pedal force from 30 to 50 pounds to maintain directional trimmed flight.

1. Adjust airspeed to approximately 300 KCAS.
2. YAW TRIM circuit breaker — Pull.
3. Takeoff trim button — Depress and hold until takeoff trim light illuminates.
4. Airspeed — As desired.

CAUTION

When yaw trim failure to either extreme occurs and the above procedure does not correct the condition, a sudden increase in aircraft yaw may be experienced when decelerating through rudder limit unlock speed (approximately 260 KCAS) if the aircraft yaw due to the hardover trim has not been removed by manual application of rudder against the out of trim. The increase in yaw will be experienced because the trim is holding the rudder against the eight degree stop when the stop is retracted.

FLAP FAILURE.

Leading Edge Flaps Failure.

The inability to obtain a desired leading edge flap position does not present any problem. Other than observing airspeed limitation presented in section V there are no restrictions on the operation of the aircraft because of any leading edge flap position. Leading edge flap deflections other than cruise and maneuver decrease cruise performance. Any leading edge flap deflection at supersonic speeds results in deterioration of acceleration and high speed performance. No change in the recommended landing approach speeds is required with leading edge flaps in any position.

Leading edge flap chatter or cycling with flap lever in CRUISE & MANEUVER is caused by intermittent activation of the flap limit switches causing the

selector valve to be turned on and off rapidly. If this condition occurs proceed as follows:

1. Flap lever — Move out of CRUISE & MANEUVER.
All other positions of the flap selector except CRUISE & MANEUVER may still be selected.

Trailing Edge Flap Failure/Split Flaps [1045] N/C/W.

Failure of the trailing edge flap screw jacks may result in a critical flight condition. The flaps should be made inoperative since any further movement of the flaps or screw jacks will only increase flight problems and increase damage to the aircraft. Should a split flap or suspected flap failure occur proceed as follows:

1. Flap lever — HOLD T.E. FLAPS.
2. Airspeed — Maintain below "Blow-up" speed of 275 KCAS.
3. T.E. FLAP circuit breaker — Pull.
(Left hand console.)

Note

If configuration of flight conditions will not allow flight below 275 KCAS, jettison external stores as necessary. Aircraft control remains the prime requirement during emergency conditions; hence, the above procedures will be attempted only after aircraft control is assured.

Trailing Edge Flap Failure/Split Flaps [1045] C/W.

- a. If a split flap is suspected, break out of formation or landing pattern and gain a

safe altitude. Keep airspeed at or below 270 KCAS until both flaps are in the full up position. Do not allow the aircraft to decelerate to below the minimum safe flying speed.

CAUTION

When a split flap condition is suspected, place the flap lever in the HOLD TE FLAPS position immediately and do not move it again.

- b. Deactivate the stab lock by pulling out the stab lock circuit breaker.
- c. Activate the Pilot Recovery System by placing the EMER STAB switch in the lock position.
- d. Use the emergency flight control switches and the other flap indicator to correct the split flap condition. Roll control may be regained by use of the emergency pitch control in the pitch down position first, and if no response, place the emergency roll control switch in the position to stop the roll, i.e., right turn, place switch in left roll position. (This applies to aircraft modified by T.O. 1F-105-1045. Aircraft modified by T.O. 1F-105-1049, the emergency pitch control and the emergency roll control switches are replaced by the emergency pitch and roll switch.)

WARNING

Before deactivating the stab lock and activating the Pilot Recovery System to correct a split flap condition, insure that a split flap condition actually exists by using the other flap indicator.

- e. When the flaps have been placed in symmetry, recheck the flap lever in the hold position and return to a normal aircraft configuration by deactivating the Pilot Recovery System, and push in the stab lock circuit breaker.
- f. Land the aircraft as soon as practical.

WARNING

The speed range that the aircraft is controllable with one trailing edge flap completely retracted and the other trailing edge flap at the 100 per cent down position (34.5 degrees), and with full fuel load including two 450-gallon pylon tanks and a full bomb-bay tank, is 200 to 275 KIAS.

The speed range that the aircraft is controllable with one trailing edge flap completely retracted and the other trailing edge flap at the 100 per cent down position (34.5 degrees), and with a full bomb-bay tank, is 185 to 275 KIAS.

With limited rudder control (plus or minus 8 degrees), lateral control is marginal in all conditions with fully split flaps.

With unlimited rudder control (plus or minus 32 degrees), lateral control is adequate in conditions stated in the first and second paragraphs of this WARNING.

Aircraft lateral control is not a direct function of power, but of the resultant velocity.

SPEED BRAKES – FAIL TO CLOSE.

If the speed brakes fail to close and a landing cannot be accomplished before fuel supply becomes critical, proceed as follows:

1.  Speed brake switch – IN.
2. SPEED BRAKE circuit breaker – Pull.
This will deenergize the speed brake circuit. If the failure is electrical the speed brake valve will be deenergized and the speed brakes will close.
3. If speed brakes remain open and it is imperative to conserve fuel:
 - a. ATM switch – STOP.
 - b. Dissipate utility hydraulic pressure.
Cycle LE flaps to bleed off residual hydraulic pressure. After hydraulic pressure is reduced, air-loads should blow the speed brake segments towards the closed position and eliminate the largest portion of the drag.
 - c. ATM switch – Hold to START until utility hydraulic pressure stabilizes 2850-3150 PSI.
 - d. AC generator switch – RESET momentarily, then ON.
4. If vertical speed brakes cannot be retracted, refer to Landing With Vertical Speed Brakes Extended.

CANOPY LOST.

Wind-blast in the cockpit is slight, up to 300 KCAS, during flight without canopy. The wind-blast increases with speed, but is acceptable up to 400 KCAS. Lower seat and select a comfortable speed below 400 KCAS.

COCKPIT SYSTEM FAILURES.**ANTI-G SUIT FAILURE TO DEFLATE**

1. Disconnect G-suit hose.

COCKPIT DEPRESSURIZATION.

If sudden depressurization of cockpit occurs or is necessary proceed as follows:

1. Oxygen diluter lever – 100% OXYGEN.
2. Descend to 25,000 feet or below, if circumstances permit.
3. Temperature control lever – RAM.

CAUTION

When the temperature control lever is moved to RAM the cockpit is decompressed rapidly.

4. If resultant temperature is too cold move temperature control lever to OFF.

WARNING

When using the normal oxygen system the oxygen diluter lever must be at 100% OXYGEN to offset effects of possible cockpit air contamination.

EXCESSIVE COCKPIT TEMPERATURE.

In the event cockpit temperature is too high and the automatic temperature control cannot correct the condition proceed as follows:

1. Temperature control lever — COLD.
2. Aircraft G suit hose — Check air flow:
 - a. If cold air is provided, Temperature Control lever — HOT-COLD range as desired for manual control.

Note

The cockpit temperature control lever may be placed in the CKPT DEFOG position long enough to clear any moisture or fogging which may collect on the windshield side panels and the canopy panels.

- b. If cold air is not provided (indicating a malfunction of the cooling turbine) proceed as follows:

- (1) Temperature control lever — RAM.

CAUTION

At low altitudes and high airspeeds (especially at high outside air temperature) the RAM position can cause excessively high cockpit air temperature which can be reduced by lowering the airspeed and/or increasing altitude.

- (2) If resultant temperature is not satisfactory, temperature control lever — OFF.
- (3) Oxygen diluter lever — 100% OXYGEN. 100% OXYGEN will offset effects of possible cockpit air contamination.
- (4) If resultant temperature is not satisfactory and/or the temperature control

lever and/or temperature control valves are stuck in the hot position, main air line shutoff valve switch — OFF. Land as soon as possible following procedures for “LANDING WITH GRAVITY FUEL FEED” and “UTILITY HYDRAULIC SYSTEM INOPERATIVE.”

- (5) If resultant temperature becomes intolerable, auxiliary canopy jettison handle — Actuate.

HYPOXIA.

If symptoms of hypoxia develop, accomplish as much of the following as necessary until satisfactory conditions are established.

1. Oxygen diluter lever — 100% OXYGEN.
2. Oxygen emergency lever — EMERGENCY.
3. If symptoms persist, bail-out bottle ball handle — Pull and descend to cabin altitude below 10,000 feet as soon as possible. Disconnect aircraft oxygen hose from connector.

The bail-out bottle contains approximately a 10 minute oxygen supply.

SPIN RECOVERY.

Fully developed spins can be expected to lose 2200 feet per turn. Recovery to level flight can be expected to require 10,000 feet. If spin is entered inadvertently, proceed as follows:

1. FLIGHT CONTROLS — POSITIVELY NEUTRALIZE.

Positive neutralization can be accomplished by depressing the trim for takeoff button and neutralizing the stick.

2. CLEAN-UP AIRCRAFT.

- a. External load — Jettison.
- b. Landing gear, TE flaps and speed brakes — Retract.

3. AFCS EMERG DISCONNECT LEVER — ACTUATE.**Note**

Direction of spin must be determined before applying correction.

- Because of the extensive oscillations in roll and pitch, the direction of spin is best determined by the needle of the turn and bank indicator or by observing the terrain OVER THE NOSE.

- For inverted spins, neutralized controls will result in recovery to an erect spin.

4. APPLY ONE HALF OR MORE AILERON WITH THE SPIN, FULL OPPOSITE RUDDER, AND SLIGHT (NOT FULL) AFT STICK.

Note

Since ATM may go off the line during a spin, equipment powered by utility hydraulic pressure may not be operable.

5. Throttle — IDLE.

6. When spin rotation stops — Neutralize controls.

Note

Because of a possible excessive trim position in pitch and/or roll, it may be necessary to place the control stick in a near neutral position.

7. If spin continues through 15,000 feet above terrain — Eject.

When spin rotation stops maintain neutralized controls even though large sideslip angles and rolls may be experienced.

CAUTION

Recovery controls are very powerful (effecting recovery in about one turn) and it is possible that secondary spins in the same or opposite direction may result from recovery. In this event, neutralize the controls and redetermine the attitude and direction of spin before attempting further recovery action.

Note

Care must be observed during the dive after spin recovery that sufficient airspeed is obtained to sustain the G of the dive recovery.

- Mild engine stalls may be experienced.
- The ATM may stop with resultant loss of utility hydraulic functions and secondary AC power.

LANDING

This phase of operation is from the initiation of the landing procedure through the landing roll. Runway emergencies are presented under the takeoff phase.

Note

The canopy should be retained for all emergency landings. See canopy retention factors under Runway Emergencies in this section.

PRECAUTIONARY PATTERN AND LANDING.

The precautionary landing pattern is slightly larger than the normal landing pattern, and is usually intercepted on base or downwind leg. The prime objective in using the precautionary landing pattern is to get the aircraft on the runway on the first attempt in as safe and effective a manner as the situation warrants. A precautionary landing pattern could be used in almost all cases of emergency and when an unsafe condition exists. Because of the many variables involved (type of emergency), position and altitude in relation to the airfield, existing weather, populated areas, approach obstacles, runway length, suitability and availability of overruns and/or barriers, etc., it is impossible to establish a prescribed precautionary landing pattern. The pilot's evaluation of all factors and his judgment will determine the type of precautionary landing pattern suitable. Such factors as pattern intercept point (downwind or base leg entry), aircraft configuration, transition point, altitude and airspeed increases above typical landing pattern positioning, size of the pattern, and glide path variations (steeper or more shallow than the normal 2.5 to 3 degrees) will have to be evaluated. Using this pattern under normal landing gross weight conditions, he would strive to maintain a reduced (constant) power setting, enter on a higher than normal base leg (possibly 2500 feet AGL), slightly farther out than normal, gear and flaps down prior to turning final, and hold approximately 210 KCAS until assured of making the runway. In the event of engine failure or fire occurring anywhere in the pattern except during the flare-out preceding touchdown, the pilot has sufficient airspeed to level off and obtain a climbing attitude for ejection. If engine failure or fire occurs during the flare portion of the landing approach, when the pilot's chance of survival is greatest by staying with the aircraft, sufficient

airspeed is available to glide to the runway while obtaining the proper attitude for landing. The pilot should strive for the normal touchdown airspeed with only minor variations from the normal touchdown point during precautionary landings. Depending on the nature of the emergency, the precautionary final approach airspeed can be up to 15% greater than that computed for a normal approach in the normal landing configuration.

LANDING GEAR FAILURES.

LANDING GEAR FAILS TO EXTEND NORMALLY.

If utility hydraulic pressure is available and the landing gear will not extend normally, proceed as follows:

1. Airspeed — Below 275 KCAS.
2. Landing gear handle — DOWN, if possible.
 - ☐ If necessary, both crew members should apply pressure to the gear handle simultaneously in an attempt to get the gear handle DOWN.
3. Landing gear emergency extension handle — Pull full aft.
4. If landing gear handle is stuck in the UP position, make second attempt to position to DOWN.
 - It may be possible to move the landing gear handle to DOWN after an emergency extension.
5. Yaw the aircraft to engage the main gear down locks and pull positive G to engage nose wheel down lock.
6. Landing gear warning light and position indicators — Check.

Check position indicators when yawing the aircraft to determine when the spring-loaded downlocks are engaged. If the landing gear handle cannot be positioned DOWN, an unsafe condition will be indicated even though the gear may be down and locked.

7. a. If the landing gear handle is DOWN and all gears indicate safe — Reset landing gear emergency extension handle full-forward and make a normal landing.
- b. If the landing gear handle cannot be positioned DOWN — Do not reset landing gear emergency extension handle.
- c. Emergency brake — Pull. Make landing with antiskid system inoperative.

WARNING

If the landing gear handle is jammed in the UP position, the landing gear emergency extension handle should not be pushed in as the landing gear will retract. The emergency extension handle should not be reset until after landing when ground safety pins are installed.

LANDING GEAR CANNOT BE EXTENDED.

If all attempts to extend the landing gear fail, **EJECTION IS NORMALLY THE BEST COURSE OF ACTION.** Landing with this configuration is not recommended. A belly landing is hazardous and the hazard is further increased if the bomb bay tank or any external tank that cannot be jettisoned contains fuel. If a fuel tank ruptures on a belly landing it may result in a fuel fed fire. Proceed as follows:

1. Eject.
2. If ejection is impossible, and a belly landing is unavoidable, accomplish as much of the following as time and conditions permit.
 - a. Reduce gross weight and minimize fire hazard.
 - Transfer bomb bay tank fuel.
 - Fire all ammunition (if feasible).
 - External stores — Jettison. (Retain empty wing tanks.)
 - Expend excess fuel.
 - b.  Safety belt and shoulder harness — Secure and LOCKED.
 - c. Speed brake switch — IN.
 - d. Flap lever — LANDING & TAKEOFF.

- e. Battery switch — OFF.
- f. Touchdown at — 190 KCAS.
— **F** 200 KCAS (650 pound fuel remaining).

Add 3 knots to speed for each 1000 pounds or portion of fuel above 650 pounds. These speeds permit touchdown in a near level attitude to avoid the nose slamming to the runway from a nose high attitude after tail contacts runway.

- g. Throttle — OFF at touchdown.
- h. Drag chute — Deploy.
- i. Attempt directional control with rudder.

ONE MAIN GEAR UP OR PARTLY RETRACTED.

Landing with this configuration is not recommended, eject.

LANDING GEAR DOWN, UNSAFE INDICATION.

It is possible that an unsafe gear down indication may be caused by a malfunction of the indicating system. To determine whether the gear or the indicating system has malfunctioned, use the following procedures.

1. Airspeed — Below 240 KIAS.
2. Utility hydraulic system pressure — Check.
3. Check four circuit breakers: LG WARNING, LG POS, LG WARNING CONTROL and LG (HANDLE) WARN LT — IN.
4. Cycle landing gear (complete cycle).

Place landing gear handle in UP position; when gear has fully retracted and locked, place handle in DOWN position.
5. Yaw the aircraft to engage the main gear down locks and pull positive G to engage nose wheel down lock.
6. Landing gear warning light and position indications — Check.

CAUTION

- If a safe indication is obtained, do not retract the landing gear because subsequent extension of all gears may be impossible.

- If the gear indicates safe but the red light in the landing gear handle remains illuminated, assume antispin failure and follow appropriate procedure. With the red light illuminated, the antiskid system will be inoperative.
- 7. *If still unsafe*, pull emergency landing gear extension handle and have gear check visually, if practical.

Have a gear position check made by the tower on a fly-by, or by another aircraft. If gear appears safe, make a normal landing.

- 8. Operate brake pedals, over half pedal travel, several times prior to landing to relieve brake pressure.

Note

After landing, do not taxi the aircraft. Stop and have crew chief install landing gear ground safety pins.

Landing Gear Down, Indicates Safe and Unsafe, LG Handle Illuminated.

(Wheel Anti-spin Failure.)

If the landing gear handle light and warning horn indicate an unsafe condition, even though all three gear indications show SAFE DOWN, it should be assumed that the anti-spin system did not de-energize and the following procedures should be followed:

- 1. Landing gear emergency extension handle – Pull full aft.
- 2. Operate brake pedals, over half pedal travel, several times prior to landing to relieve brake pressure.

NOSE GEAR UP OR UNSAFE.

If the nose gear remains up or in an intermediate position after all attempts to extend it have failed, use the following procedure.

- 1. Reduce weight.
If time and conditions permit, expend excess fuel and fire all ammunition to lighten the aircraft and to minimize fire hazard.

- 2. External stores – Jettison.

Jettison all external stores.

- 3. Safety belt and shoulder harness – Secure and LOCKED.
- 4. Speed brake switch – OUT.
- 5. Flap lever – LANDING & TAKEOFF.
- 6. Battery switch – OFF.
- 7. Touchdown in center of runway.
- 8. Drag chute – Deploy.
- 9. LOWER NOSE GENTLY TO RUNWAY AT APPROXIMATELY 150 KCAS.

WARNING

If the nose falls through it may contact the runway with enough force to cause structural damage to the aircraft and possible pilot injury.

- 10. After directional control is assured, throttle – OFF, emergency brake handle-PULL.

WARNING

Keep feet off brakes when emergency brake handle is pulled. Brake pressure will result in a nose downward moment.

- 11. Do not apply brakes unless necessary.

Use brakes only for directional control unless stopping distance is critical. After nose contacts runway, approximately 2500 to 3000 feet are required to stop on a dry runway without using brakes.

NOSE WHEEL NOT CENTERED OR TORQUE LINKS DISCONNECTED.

If it is suspected that the nose gear is not centered after takeoff, accomplish the following:

- 1. Leave landing gear extended.
- 2. Have a visual check made to determine if the nose gear is cocked or the torque links not connected.

If either or both conditions exist:

- 3. Leave landing gear extended.

4. Burn out fuel to normal landing gross weight.
5. Make a normal approach and landing.
6. With main gear on runway engage nose wheel steering momentarily.
7. Lower the nose gently to runway at approximately 150 knots.

The aircraft will lurch as the nose wheel casters straight ahead; however, the lurch is controllable with rudder.

Note

Experience has shown that as weight on the nose gear is increased, with the torque links disconnected, braking action causes nose wheel shimmy to intensify. Foaming of runway decreases the intensity of the shimmy appreciably.

NOSE WHEEL TIRE FAILURE.

If nose wheel tire failed on takeoff, reduce weight prior to landing. When landing deploy drag chute as soon as possible and gently lower nose wheel to runway before speed reduces to approximately 150 KCAS. On the runway hold full up stabilizer to relieve as much pressure as possible on the nose wheel. Use differential braking and nose wheel steering to maintain directional control. If nose wheel steering becomes uncontrollable, it should be disengaged.

TIRE FAILURE DURING LANDING.

If either main wheel tire failed on takeoff, reduce weight, position antiskid switch off and land on side of runway opposite failed tire and deploy drag chute as soon as possible. If a tire fails on landing, position the antiskid switch to off immediately. During the landing roll as vibration increases the brake should be held and locked on the wheel with the failed tire. Use nose wheel steering to maintain directional control.

1. ANTISKID – OFF.

WARNING

Do not stopcock the engine, but maintain idle RPM until fire equipment arrives. Stopcocking the engine allows fuel to

vent in the vicinity of the wheel brake area creating a fire hazard.

Wheel Brake Failure.

1. Emergency brake – Pull.

Only three full brake applications available. Each reduction in brake pressure bleeds off the total amount of hydraulic fluid available.

TAIL SCRAPE ON TAKEOFF OR GO AROUND.

Have visual check of arresting hook position made prior to landing. (**F** regardless of caution light indication.)

ARRESTING HOOK EXTENDED.

1. Make normal landing beyond barrier on approach end of runway.
2. After landing, do not stopcock engine.

WARNING

Maintain idle RPM until fire equipment arrives to cool hook. Stop cocking engine will allow fuel to vent in vicinity of hook.

CAUTION

The pilot must take into consideration that the arresting hook extends well below the main gear tires in the normal landing attitude.

BARRIER ENGAGEMENT.

1. THROTTLE – IDLE (OFF FOR FIRE AND EMERGENCY BRAKE – PULL.)
2. EXTERNAL LOAD – JETTISON (if necessary).
3. DRAG CHUTE – DEPLOY.

If stores are jettisoned, delay deployment as long as possible to minimize possibility of stores overtaking aircraft.

4. ARRESTING HOOK – EXTEND. (Mid field and approach end engagement of any barrier should not be attempted.)

5. Brakes — Apply optimum.

- If emergency brake handle is pulled, antiskid is inoperative.
- If a main tire fails, antiskid switch — OFF, use differential braking and nose wheel steering, as vibration increases the brake should be held and locked on the failed tire.

6. Attempt to engage barrier squarely.

Normally the throttle will be positioned to idle which will permit the aircraft to taxi clear of the runway after a hook engagement.

If the throttle is positioned to OFF, accomplish as much of the following as possible prior to engaging barrier.

- Emergency brake — Pull.
-  Shoulder harness — LOCKED.
- Fuel tank selector switch — OFF [997C and 1044] N/C/W.
- Fuel shutoff switch — SHUTOFF [997C or 1044] C/W.
- Battery switch — OFF.

CAUTION

When the aircraft is approaching the barrier with the nose extremely low, and it is imperative that the barrier cable be engaged, the brakes should be released prior to crossing the cable.

UTILITY HYDRAULIC SYSTEM INOPERATIVE.

Landing with the utility hydraulic system inoperative will involve an emergency extension of the landing gear and landing without leading edge flaps, speed brakes, nose wheel steering, normal brakes and antiskid.

- External stores — Jettison as required.
- Reduce weight as much as possible.
- Landing gear handle — DOWN.
- Landing gear emergency extension handle — Pull full aft.
- Yaw aircraft to engage the main gear down locks and pull positive G to engage nose wheel down lock.

6. Landing gear warning and position indicators — Check.

7. Flap lever — LANDING & TAKEOFF.

8. Make normal touchdown.

9. Drag chute — Deploy (after touchdown).

10. Throttle — OFF and emergency brake — Pull.

Note

Landing lights will become inoperative when engine RPM drops below DC generator cut-in speed.

11. Use maximum aerodynamic braking.

12. Brakes — Apply moderate wheel braking, as speed decreases, increase to heavy braking, modulate as necessary to maintain directional control.

Only three full brake applications are available. Each reduction in brake pedal pressure bleeds off the total amount of hydraulic fluid available.

WARNING

Once the emergency brake system has been depleted through repeated applications of the brakes, the aircraft is free to move if the utility hydraulic system is inoperative. Therefore, maintain pedal pressure when the aircraft has been stopped and do not release the brakes until after the aircraft has been chocked by ground crew personnel.

13. Stop straight ahead (do not taxi aircraft), or arresting hook switch — DOWN for barrier engagement.

GRAVITY FUEL FEED.

During operation with AC electrical failure the fuel tank boost pumps will be inoperative. Under this condition the forward and aft tanks will discontinue transferring fuel to the main tank and all internal tanks will gravity feed directly to the engine. The main tank will feed fuel faster and drop to a level of approximately 300 pounds with only a small decrease in the forward and aft tank quantities. The forward and aft tanks will then gravity feed with

the forward tank feeding at a higher rate than the aft tank. As the fuel heads equalize, the fuel remaining in each tank will gravity feed until all usable fuel is consumed.

In the event a landing must be made with gravity fuel feed to the engine as a result of loss of AC electrical power or any other condition that makes the boost pumps in tanks containing fuel inoperative proceed as follows:

1. When descent is initiated:

- a. *If fuel quantity in the main tank is above 1100 pounds* (fuel low level caution light not illuminated) and a descent and landing can be completed with this fuel, proceed with a normal descent and landing.
- b. *If fuel quantity in the main tank is below 1100 pounds* (fuel low level caution light illuminated) or a penetration descent is necessary and main tank fuel marginal for completing a landing:
 - (1) Avoid perceptible decelerations and large negative pitch angles as these will uncover the aft gravity feed ports and may cause interruption of aft tank fuel flow.
 - (2) Make descent at a speed of 250 KIAS or less.
 - (3) Extend landing gear at any speed below 225 KIAS in the landing pattern.
 - (4) Extend flaps when below 200 KIAS on short final.
 - (5) Do not use speed brakes when in landing pattern in order to prevent sudden deceleration and interruption of fuel flow.

Note

A normal landing can be accomplished even though the CG may be aft of the permissible CG limit. The aircraft will have positive stability, however, caution should be used to avoid abrupt control movement or uncoordinated maneuvers.

CG OUT OF LIMITS.

AFT CG.

A landing can be accomplished even though the CG may be aft of the permissible CG limit. If unable to

correct an aft CG condition before landing, proceed as follows:

1. External stores — Jettison as required.
2. Avoid large control movements.
3. Make a power on flat approach.
4. Avoid any abrupt flare action and be alert to correct nose pitch-up after touchdown.

FORWARD CG.

A landing can be accomplished even though the CG may be forward of the permissible CG limits. If unable to correct a forward CG condition before landing proceed as follows:

1. Make a power on flat approach.
2. Avoid large control movements and any abrupt flare action. Keep pumping action to a minimum.
3. After touchdown the nose will tend to fall through at higher than normal speeds.

ONE FULL WING PYLON TANK OR EQUIVALENT WEIGHT STORE.

If one wing pylon tank fails to feed or a heavy store is retained, an asymmetrical load condition will result. See Flight with Asymmetrical Loads in section VI.

WARNING

With one full 450 gallon wing pylon tank, or equivalent weight store, and trailing edge flaps retracted full lateral control is required to hold wings level at 200 KCAS. At lower speeds lateral control is insufficient to hold wings level. If store cannot be jettisoned, and trailing edge flaps cannot be extended, add 20 percent to pattern and landing speeds.

1. External tanks — Jettison as required. If landing with retained store, retain tank.
2. If tanks are not jettisoned proceed as follows:
 - a. Determine best controllable approach speed.

- b. Make precautionary base leg (make turns away from heavy wing).
- c. Increase pattern and landing speed 10 percent above airspeed required for gross weight.
- d. Drag chute — Deploy at normal speed.
- e. Complete normal landing procedure.

FLAPS UP.

1. Reduce weight.
2. Flap lever — HOLD TE FLAPS.
The HOLD TE FLAP position will prevent unexpected movement.
3. Increase pattern and landing speed 15 percent or appropriate proportion for partial TE flap extension.
4. Approach at 2.5 or 3.0 degree glide slope.

WARNING

Prior to landing, check for full travel of the rudder pedals. If flaps fail to extend due to failure of the airspeed sensing switch, the rudder stops will not retract and the rudder travel caution light will not illuminate. Under this condition, directional control in a crosswind condition will be marginal unless the RUDDER CONTROL C/B is pulled.

VERTICAL SPEED BRAKES EXTENDED.

1. Land with minimum fuel.
2. Use a flat approach using a slightly lower than normal pitch attitude. Increase normal touchdown speed by 10 percent.
3. Lower nose immediately.

Note

Due to the vertical speed brakes being extended the drag chute and wheel antiskid may not be available.

FORCED LANDING.

FORCED LANDING/DECISION FACTORS.

Forced landings are dangerous and should be attempted only under ideal conditions.

EJECTION IS NORMALLY THE BEST COURSE OF ACTION. The following instructions are presented as a guide.

- Forced landings should not be attempted by pilots who are not proficient in simulated forced landing approaches in this aircraft.
- Forced landings should not be attempted at night, dusk or dawn, regardless of weather or field lighting.
- Forced landings should not be attempted unless ideal weather conditions exist. Cloud cover, ceiling, visibility, turbulence, surface winds, etc., must not impede in any manner the establishment of proper forced landing pattern.
- Forced landing should not be attempted where approaches have obstacles or are over heavily populated areas.
- Forced landing should not be attempted on other than a prepared or designated suitable surface.
- Forced landings should not be made unless the landing gear is fully extended. Investigation has shown that even when landing on reasonably rough terrain the extended gear absorbs the initial impact and results in less pilot injury and aircraft damage.
- Forced landings should not be attempted without fully extended trailing edge flaps. Without trailing edge flaps the lift required for round out at flame-out descent rates necessitates a dangerously high angle of attack with probability of severe damage in landing.
- Air start attempts should be completed before high key is reached so that complete attention may be devoted to accomplishing a successful forced landing pattern. Further airstart attempts down to low key may be made, provided that primary attention is devoted to proper execution of the forced landing pattern.
- Do not continue attempting air starts after low key is reached as successful completion of forced landing requires complete attention.

This does not preclude air start attempts when flame-out occurs below low key.

- Forced landings should not be attempted when a satisfactory "High Key" or "Low Key" cannot be achieved.
- Forced landings should not be attempted or continued if optimum airspeed cannot be maintained. Airspeed is critical. If it falls below optimum, considerable altitude will be lost in attempting to regain it. If below optimum after low key successful completion of the landing is unlikely.
- Forced landing should not be attempted if at any time during the approach, conditions do not appear ideal for successful completion of the landing. Eject no later than base leg altitude.

FORCED LANDING PROCEDURE.

The forced landing pattern shown in figure 3-9 was developed from flight test. The ideal high key point is 12,000 feet above runway elevation. If more than 5000 pounds of fuel remain, the high key altitude must be increased 2000 feet. A minimum high key of 10,000 feet can be used with less than 1000 pounds of fuel remaining; however, a tighter than normal pattern (approximately 45 degree bank) will be required.

Configuration. The glide to high key is accomplished with aircraft clean (i.e., external stores jettisoned, speed brakes closed or in trail, TE flaps retracted, landing gear up and RAT extended). The retracted TE flaps will provide maximum distance in straight gliding flight. At high key, both the landing gear and TE flaps are extended. This configuration is established early in the pattern to provide optimum control and to permit adjusting the pattern while there is still altitude to work with. It avoids trim change, sudden increase in rate of descent and distraction from the touchdown point during the more critical phase of the pattern. The fully extended TE flaps provide optimum control in the turning pattern and in the ideal pattern of 30 - 40 degree bank where slight G is involved, the increased lift from full TE flaps more than offsets the increased drag and the rate of descent is reduced. Full TE flaps are required to provide the necessary lift for round out. Partial TE flap settings should not be used as they do not offer any increase in performance in the spiral or turning portion of the pattern and will increase the rate of descent during straight unaccelerated flight.

WARNING

Trailing edge flaps will retract automatically if speed is increased to approximately 275 KCAS and an excessive sink rate may develop. Flaps will not extend until speed is reduced to approximately 260 KCAS.

Pattern and Technique. Although a windmilling engine will normally provide hydraulic pressure at recommended glide speed the volume output is not sufficient for the landing phase, therefore the RAT must be extended. The RAT alone will supply adequate hydraulic power for flight control down to approximately 70 knots. The turn from high key should be initiated when the aircraft crosses the approach end of the runway in order to actually have the turn established by the intended touchdown point. Appropriate speed should be maintained throughout the pattern and position and altitude regulated by bank angle. High ambient temperatures (above 85°F) increase the rate of descent due to the higher true airspeed for a constant indicated speed. A helpful technique, used during flight test to aid in hitting the desired touchdown, involves checking that 25 percent of the high key altitude is lost during each 90 degrees of the 360 degree pattern. This technique requires that if a 90 degree check point relative to the runway heading is reached at too high an altitude, the aircraft is rolled out and flown straight until the desired altitude is reached. If the altitude is too low, the turn is tightened to reach the next 90 degree check point at the desired altitude.

WARNING

Prolonged bank angles of greater than 45 degrees increase the rate of descent drastically and should be avoided particularly after low key. The proper speed is very important throughout the pattern and critical at the 1000 foot point when the wings are level and decreasing the rate of descent is initiated. Round out, or attempts to check rate of descent should not be attempted while still in a banked attitude as rate of descent will not be checked and airspeed may be lost.

The aircraft should be lined up with the runway with wings level at approximately the 1000 foot point. Start to reduce rate of descent at this point.

FORCED LANDING

WINDMILLING OR FROZEN ENGINE 360° APPROACH

TO ACHIEVE HIGH KEY:

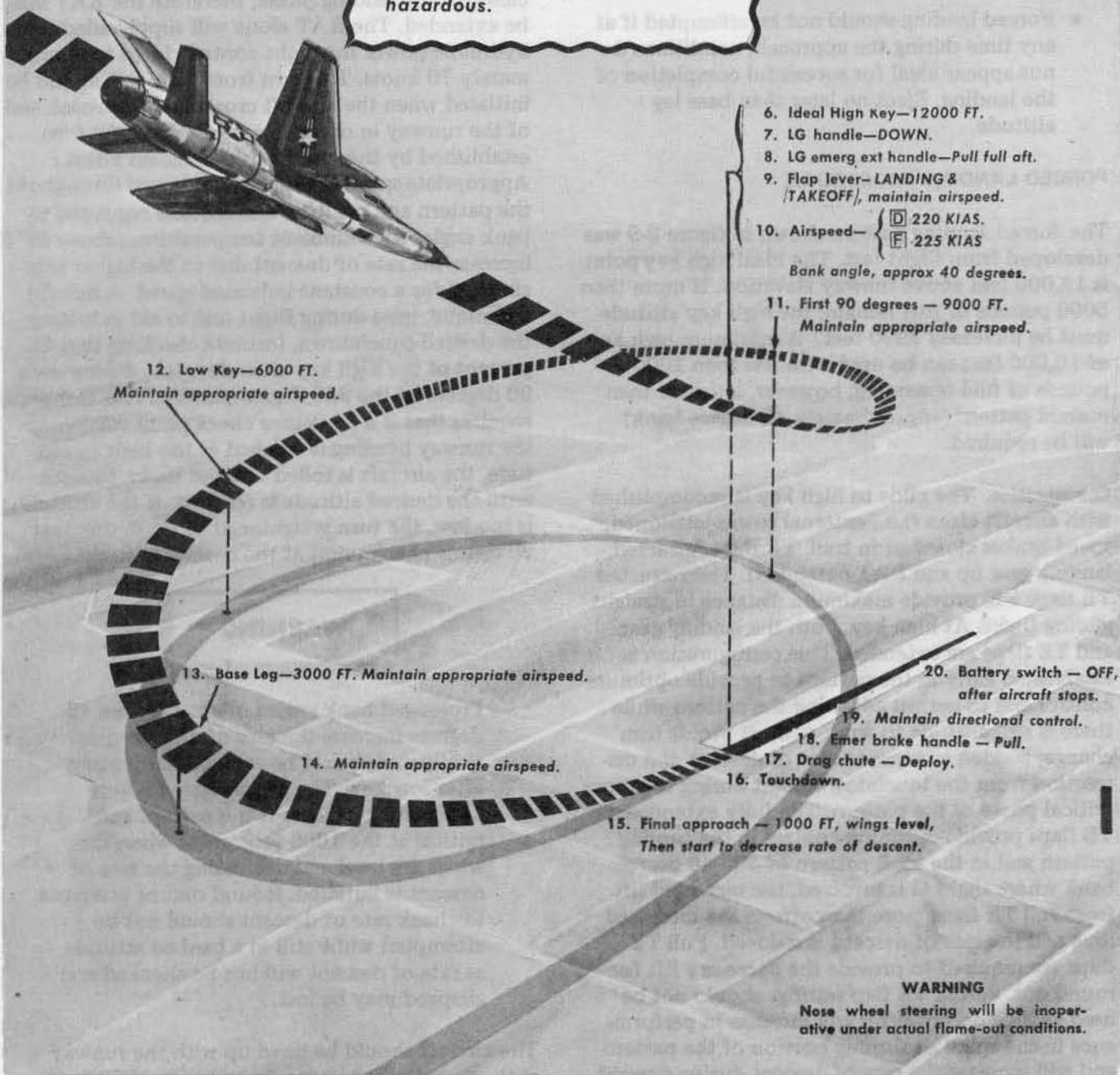
1. External stores — Jettison.
2. Rat — EXTEND.
3. Speed brakes — IN.
4. Clean glide speed — { **D** 250 KIAS
 F 255 KIAS
5. Zero delay lanyard — Attach.
 110381 N/C/W

WARNING

Airspeed is critical. If it falls below optimum, considerable altitude will be lost in attempting to regain it. If airspeed is below optimum after low key, successful completion of the landing is unlikely. If airspeed exceeds 270 KIAS, flap blow up may occur making pattern more hazardous.

NOTES

- Altitudes are above runway elevation.
- Add 2000 feet to High Key for more than 5000 LB of fuel.
- Add 3 knots to speed for each 1000 LB of additional weight.



WARNING

Nose wheel steering will be inoperative under actual flame-out conditions.

Figure 3-8

The preceding comments and procedure apply to the situation where sufficient altitude exists to permit attaining high key. If the decision is made to land when high key cannot be attained, pick up the pattern at the highest altitude possible, but not lower than low key. The decision for LG and TE flap extension would then be determined by how well you are doing in establishing the prescribed pattern. The important factors are: (1) In straight gliding flight retracted flaps will stretch the glide; (2) Extended landing gear increases rate of descent; (3) In the turning pattern extended TE flaps reduce rate of descent and improve control with the landing gear either extended or retracted.

SIMULATED FORCED LANDING.

Since flame-out descents are simulated by a thrust-drag configuration equivalent to a windmilling or frozen engine, the speed brakes are fully opened and the thrust set at the proper level. However, since the top and bottom speed brakes close when the landing gear is extended, a lower thrust setting is required with the landing gear down than with the gear up and all four speed brakes extended. Therefore, in the gear down portion of the pattern, idle thrust should be used. Leading edge flaps will not be movable during actual flame-out conditions, therefore, simulation should be accomplished with them in the "CRUISE AND MANEUVER" position. (Buffet may be encountered earlier and a slightly higher attitude will be required during round out, especially at higher gross weights.) "CRUISE AND MANEUVER" is used because the flaps will normally be in this position. The "CRUISE AND MANEUVER" position can be held by pulling the LE FLAP circuit breaker while the flaps are in the "CRUISE AND MANEUVER" position and prior to extending the TE flaps. Stability Augmentation will be inoperative during actual flame-out landings and as the tape instruments will also be inoperative the standby airspeed indicator, the standby attitude indicator and altimeter should be used. The two configurations for the simulated forced landing are as follows:

To Achieve High Key or Intercept Pattern.

- a. RAT — Simulate extension (touch lever).
- b. Speed brakes — OUT.
- c. Throttle — 85 percent RPM.
- d. Flap lever - CRUISE & MANEUVER.

To Accomplish the Turning Pattern.

- a. Speed Brakes — OUT.
- b. Throttle — IDLE.
- c. LG DOWN (top and bottom speed brakes will retract).
- d. Flap lever — LANDING AND TAKEOFF.

Note

When initiating a go-around from the simulated forced landing pattern, allow sufficient time for engine acceleration from IDLE to MILITARY THRUST, approximately 6 seconds.

DITCHING.

All emergency survival equipment is designed as part of the escape system and is carried by the pilot during ejection. There is no advantage in riding the aircraft down, therefore *ditch only as a last resort*. The following is provided as a guide in the event that ejection is not possible and ditching is unavoidable.

- a. Distress procedure — Radio, IFF/SIF.
- b. Aircraft configuration — clean, flaps — LANDING & TAKEOFF. Landing gear — UP, external stores — Jettisoned, speed brakes — IN.
- c. Oxygen diluter lever — 100% OXYGEN.

When the diluter lever is set at 100% OXYGEN the regulator is a suitable underwater breathing device and may be used for temporary underwater survival in the event you are delayed in escaping from cockpit. It is essential that the oxygen mask be tightly strapped in place. *The bailout bottle cannot be used under water.*

- d.  Disconnect all personal leads except oxygen.
- e.  Safety belt and shoulder harness — Secure and LOCKED.
- f.  Pull helmet visor down and auxiliary canopy handle — Actuate and pull up.

The canopy will jettison without arming the seat.

g. Battery and generator switches — OFF.

h. Use normal approach and touchdown, throttle — OFF at touchdown.

Unless wind is high or sea is rough, plan approach heading parallel to any uniform swell pattern, and try to touchdown along a wave crest or just after the crest passes. If wind is as high as 25 knots or surface is irregular, the best procedure is to approach into the wind and touchdown on the falling side of a wave. Do not stall the aircraft at the time of contact.

i.  When forward motion stops, open safety belt remove parachute, and disconnect oxygen.

j.  Exit from cockpit.

WARNING

Do not jeopardize your escape from the aircraft attempting to retrieve the survival kit.

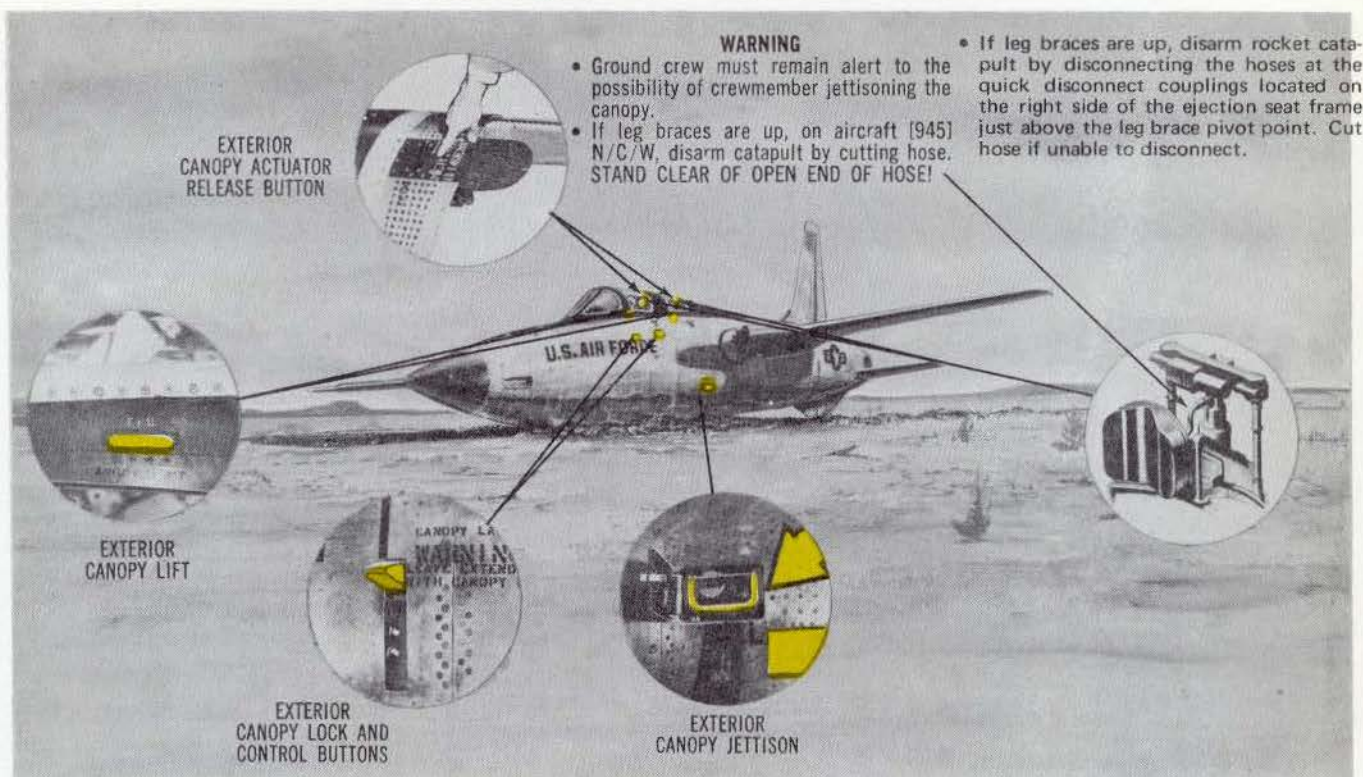
EMERGENCY ENTRANCE.

See figure 3-10.

ABBREVIATED CHECKLIST.

Your emergency procedure abbreviated checklist is contained in T.O. 1F-105D-1CL-1.

EMERGENCY ENTRANCE



NORMAL ENTRANCE

1. Exterior canopy lock lever — Raise.
2. Exterior canopy control button — Depress.

MANUAL ENTRANCE

1. Exterior canopy lock lever — Raise.
 2. Exterior canopy actuator release button — Depress.
 3. Raise canopy manually.
- CAUTION:** Hold canopy open as uplocks are not provided.

EMERGENCY ENTRANCE

IN THE EVENT NORMAL OR MANUAL ENTRANCE IS NOT POSSIBLE OR FEASIBLE.

1. Push latch and open cover.
2. Exterior canopy jettison handle — Pull out 6 feet. Stand clear of canopy. ☐ Both canopies will jettison.

IF CANOPY CANNOT BE JETTISONED — strike plastic along its edge attachment with the pointed end of a fireman's pike axe to produce a series of punctures outlining an escape hole. Strike punctures with broad edge of axe to open escape hole.

WHEN ACCESS TO COCKPITS IS GAINED

1. Disconnect pilot's personal equipment leads.
2. Open seat safety belt. Shoulder harness will release and on aircraft [1083] C/W the leg lanyards will also release.
3. Disconnect parachute firing cable from parachute deployment gun actuator and unstrap parachute by releasing the breast strap and the two crotch strap ejector snaps [1038] C/W.

WARNING [1038] C/W

The force-deployed parachute contains a ballistically fired deployment gun. Extreme cau-

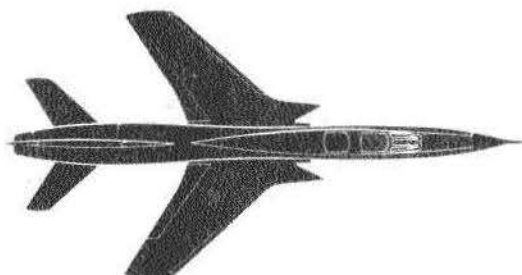
tion shall be exercised any time parachute is handled. Ensure that safety pin, streamer, and dust cap are always engaged in cable assembly to prevent deployment gun being discharged when cable assembly is not connected to actuator on ejection seat. Hold parachute so that barrel of deployment gun points away from all personnel and towards a suitable parapet in case of discharge.

4. Pull emergency release handle on right side of survival kit to disconnect kit from parachute.

Figure 3-9

Section IV

CREW DUTIES



Not applicable to this aircraft.

Section V

OPERATING LIMITATIONS

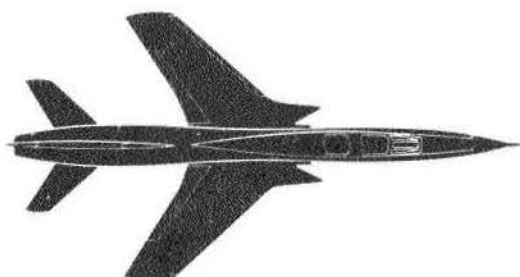


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MINIMUM CREW REQUIREMENTS. [F]

The minimum crew is one pilot who shall occupy the front cockpit. When a pilot occupies the rear cockpit as a crewmember the pilot in the front cockpit is in command.

INSTRUMENT MARKINGS.

This section includes the limitations that must be observed for the safe and efficient operation of the engine and aircraft. Markings on instruments form a part of these limitations; however, they are not repeated in the text and must be referred to on the instrument marking page (figure 5-1). Where necessary, further explanation of the instrument

markings are covered in the text of this section under the appropriate heading.

ENGINE LIMITATIONS.

Normal engine limitations are shown in figure 5-1. MAXIMUM THRUST (afterburner thrust) is that obtained by placing the throttle full-forward and outboard for afterburner operation. MILITARY THRUST is that obtained by placing the throttle full-forward and inboard (nonafterburning). MAXIMUM CONTINUOUS THRUST is defined as the thrust obtained at 575°C EGT. WATER INJECTION THRUST is obtained with the throttle in maximum thrust (full afterburner) and injecting water into the engine.

INSTRUMENT MARKINGS BASED ON JP-4 FUEL



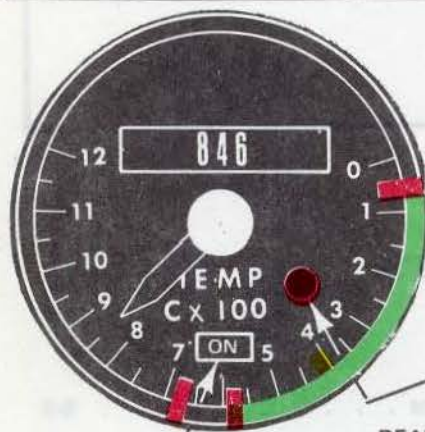
NOTE
RPM should be increased steadily during start to 68.0 to 71.0 percent, without hang up, within one minute

TACHOMETER

106.5 Per Cent	Maximum allowable
85.0-98.0 Per Cent	Normal operating range
68.0-71.0 Per Cent	Normal Idle
68.0-78.0 Per Cent	Emergency Idle

EXHAUST GAS TEMPERATURE

400°C MAX	Starting
50°C MIN	Operating
50°C to 575°C	Continuous
575°C MAX	Continuous
635°C MAX	5 minutes, MIL THRUST on ground
	20 seconds, MAX THRUST on ground
	30 minutes, MIL THRUST in flight
	15 minutes, MAX THRUST DRY in flight
650°C MAX	Two minutes during and just after accel or A/B starts above 25000 feet. Note: The two minute time interval begins immediately after forward throttle motion is stopped.
660°C MAX	One minute MAX THRUST WET during takeoff. (Note: This time interval applies only during the two minutes immediately after forward throttle motion is stopped).
675°C MAX	Zero to five seconds DRY during and just after accel or A/B starts above 25000 feet. Thirty seconds WET during takeoff. (Note: Both time intervals apply only during the two minutes immediately after forward throttle motion is stopped).
340°C	Idle MAXIMUM



OVERTEMP LIGHT
660°C

READS "OFF" WHEN POWER IS OFF

340°C

Idle MAXIMUM

OIL PRESSURE GAGE

35 psi	Minimum during idle
35-40 psi	Caution
40-50 psi	Normal
80 psi	Maximum for short periods during takeoff and climb.

NOTE: Allowable fluctuation 5 PSI within normal range.



OIL LOW PRESS

OIL PRESSURE CAUTION LIGHT

ON Between 39 and 23 PSI on decreasing pressure
OFF Between 28 and 45 PSI on increasing pressure

FUEL FLOW INDICATOR

700 pph	Minimum
700-20200 pph	Normal
20200 pph	Maximum

NOTE: When throttle is retarded to IDLE, gage may indicate 625 PPH momentarily.



Figure 5-1 (Sheet 1 of 2)

PRIMARY ONE HYDRAULIC SYSTEM PRESSURE



2850-3150 psi	Normal
3150-3500 psi	Momentary permissible range
3500 psi	Maximum
3300-3700 psi	Normal for emergency system
[1049] N/C/W	

PRIMARY TWO HYDRAULIC SYSTEM PRESSURE



2850-3150 psi	Normal
3150-3500 psi	Momentary permissible range
3500 psi	Maximum
[1049] C/W 3300-3700 psi emergency	

UTILITY HYDRAULIC SYSTEM PRESSURE



2850-3150 psi	Normal
3150-3500 psi	Momentary permissible range
3500 psi	Maximum

DISPLACING GEAR PRESSURE INDICATOR



0 psi	Normal when carrying bomb bay tank or MN-1A
0-50 psi	Initiator release Slow to 600 KIAS at 1-1.5G
50-190 psi	Normal release all modes Slow to 600 KIAS at 1-1.5G
190-300 psi	Normal all modes
300 psi	Maximum
250 psi	Ground check
Gage tolerance 25 PSI	

Figure 5-1 (Sheet 2 of 2)

GROUND OPERATING LIMITS.

1. During ground operation, do not extend the duct plugs to full forward position, when engine speed is greater than 80 percent RPM.
2. Engine runup.
 - a. Aircraft restrained with chocks only [use 6-inch chocks (minimum) and apply full brakes for runup]. Do not check afterburner.
 - b. Aircraft restrained with cable — Light afterburner at normal minimum afterburner throttle position, then advance throttle.
3. Speed brakes must be in their normal scheduled position speed brake switch — IN, except during speed brake check.
4. Operation at Military Thrust will not exceed 5 minutes.
5. Operation at Maximum Thrust, dry or with water injection, will not exceed 20 seconds. Operation may be repeated as often as required provided non — A/B operation is selected for a 5-minute cooling period.

EFFECTS OF HIGH EGT ON ENGINE LIFE.

Operation of the engine for extended periods at high thrust and EGT levels is the primary cause of damage to hot section components. Operation in the EGT range above 575°C should be avoided as much as possible.

ENGINE ACCELERATION LIMITS.

Acceleration time from IDLE to maximum RPM at sea level static conditions should not be more than 15 seconds. Normal engine acceleration occurs in approximately 6 seconds. During start, the engine should accelerate to 68.0 to 71.0 percent, without hangup, within 1 minute.

ENGINE OVERSPEED LIMITS.

Maximum permissible engine speed is 106.5 percent RPM. Any engine speed in excess of 106.5 percent RPM should be noted in AFTO Form 781, and the engine visually inspected for damage. Speed in excess of 108.0 RPM will necessitate engine overhaul.

EXTENDED AFTERBURNER RANGE LIMITS.

1. Use of extended A/B range (85 to 93 percent RPM) is limited to air refueling only between 15,000 and 38,000 feet.

Between 15,000 and 25,000 feet with the throttle at the minimum A/B stop some vibration or instability may occur. An increase in RPM of several percent will eliminate it. Use of extended A/B range below 15,000 feet may cause engine surges or stalls.

2. Do not attempt an A/B light-up when throttle is in the extended A/B range as flame-out may occur.
3. Do not use extended A/B range when operating on the emergency fuel system as the A/B may blow out.
4. Afterburner operation below 15,000 feet altitude is limited to the range of 93 percent to maximum permissible RPM.

WATER INJECTION LIMITATION.

Water injection will be used only during takeoff below 8000 feet in ambient temperatures of 40°F (4.4°C) and higher.

ALTERNATE FUEL RESTRICTIONS.

Fuel Grade Properties and Limits.

Alternate fuels are defined as fuels which may be substituted for the recommended fuel with possible restriction to aircraft performance. Alternate fuels will not cause permanent damage to the engine or fuel systems; however, they may require engine retrim. Figure 5-2 lists fuel in order of preference.

Note

Aviation gasoline and JP-4 fuel mixed in any proportion are suitable for continuous operation from an engine performance standpoint. However, the use of aviation gasoline must be restricted to emergency evacuation or one-time ferry-type missions to minimize undesirable lead deposits in the engines and to avoid damage to the engine driven fuel pump due to the poor lubricating properties of aviation gasoline.

FUEL GRADE PROPERTIES and limits

FUEL	FUEL TYPE	GRADE	NATO SYMBOL	US MILITARY SPECIFICATION	UNITED KINGDOM SPECIFICATION	SPECIFIC GRAVITY (MAX-MIN AT 60°F)	FREEZE POINT °F	LIMITS
RECOMMENDED	Wide Cut Gasoline	JP-4	F-40	MIL-J-5624	DERD 2486	0.802-0.721	-76	
ALTERNATE	Wide Cut Gasoline	Comm. Jet B	None	ASTM		0.802-0.751	-60	(A) (C)
	Kerosene	Comm. Jet A-1	None	ASTM		0.829-0.775	-58	(A) (C)
		Comm. Jet A	None	ASTM		0.829-0.775	-40	(A) (C)
			F-34	None	DERD 2494		-58	(C)
		JP-5	F-44	MIL-J-5624	DERD 2488	0.845-0.788	-55	(C)
EMERGENCY	Aviation Gasoline (AVGAS) Plus 3% Grade 1100 Oil	80/87	F-12	MIL-G-5572		0.706 (D)	-76	(B)
		91/96	F-15	MIL-G-5572		0.709 (D)	-76	(B)
		100/130	F-18	MIL-G-5572		0.702 (D)	-76	(B)
		115/145	F-22	MIL-G-5572		0.706 (D)	-76	(B)

(A) Prior to using commercial fuel, obtain freeze point from vendor or airline supplying fuel. Exercise caution if you suspect or observe improper fuel handling procedures. If there is any indication that cleanliness is not up to standard, a fuel sample should be taken in a glass container and observed for fogginess, presence of water or rust.
 (B) Follow climb restrictions.
 (C) Avoid flying at altitudes where OAT is below the freeze point of the fuel.
 (D) Average value-limits are not controlled by specification.

Figure 5-2

Use of approved kerosene type alternate fuels will not adversely affect engine performance. Generally the full takeoff rating will be more readily available with the denser kerosene type fuels while aircraft range performance will be at least as good or slightly better than with JP-4. With cold fuel, ground starts and restarts at high altitude may be slower and less consistent with the denser fuels such as JP-5. Only during use of aviation gasoline (AVGAS) will it generally be necessary to retrim engines to obtain the full takeoff rating. It is recommended that, if a landing is made at a base having only aviation gasoline available and no facilities for engine retrimming, only enough fuel be loaded to accomplish a one-time flight to a base where JP-4 is available. The engine operating limitations discussed under Engine Limitations, in this section, also apply to alternate and emergency fuels.

Gasoline and JP-4 fuel mixtures that contain less than 10% gasoline in all fueled tanks have no climb rate limitations. When fuel mixtures containing more than 10% gasoline are used, do not exceed 5000 feet/min. rate of climb above 1500 feet

altitude when fuel temperature is above 80° F. The fuel tank and vent system is not designed to handle high vapor pressure fuel. As a result, excessive fuel venting will occur coupled with the buildup of high internal tank pressures which may cause damage to the fuel system.

The OAT is approximately 25° C (45° F) degrees above ambient static air temperature at Mach 0.8 in ambient air colder than -40° C. This higher temperature is due to airspeed ram effect. The ram heating effect also maintains the airframes and fuel, a like number of degrees above ambient static temperature. Therefore, flights through -54° C (-65° F) ambient static temperature at 0.8M will result in fuel tank temperatures approaching -25° C (-20° F). To insure boost pump and engine fuel feed system performance, aircraft altitude should be adjusted to insure flying with the OAT above the fuel freeze point when using alternate fuel grades.

JP-4 is the only fuel which presently contains an anti-icing additive to prevent fuel filter icing, due to moisture in the fuel.

The fuel flow indicator measures volume per hour flow, but presents the pilot with a pound per hour indication. The use of the higher density fuels will result in a fuel flow indication that is somewhat lower than the actual flow; however, speed and range will not be affected. Conversely, lower density fuels (AVGAS) will present a fuel flow indication that is somewhat higher than the actual flow; however, in this case, speed will not be affected but range will be reduced by a factor of approximately 7 percent due to the lower heating value of the fuel on a volume basis. The fuel quantity gage system will read approximately 1 percent higher when using aviation gasoline. Fuel quantity gage system error will be negligible when other alternate fuels are used.

FUEL SYSTEM LIMITATIONS.

FUEL TANK SELECTOR SWITCH.

The fuel tank selector switch will be positioned from the front cockpit only. Care must be exercised to make certain that the switch is in the exact center of the selected detent position. The mechanical linkage between the front and rear switches is such that the detent is not easily felt in the rear cockpit.

AIRSPPEED LIMITATIONS.

Note

Speeds indicated on the AMI are in KCAS.

MAXIMUM SPEED.

For maximum allowable airspeed refer to figures 5-5 and 5-7.

CAUTION

-  The maximum allowable speed marker on the AMI indicates maximum allowable Mach number as a function of altitude. This marker is not correct at the present time and should not be used to determine the maximum safe speed.

MINIMUM SPEED.

For minimum speeds for various gross weights refer to figure 6-1.

LANDING GEAR.

1. Landing gear retraction speed, 240 KCAS maximum until locked up.
2. Landing gear extension speed, 275 KCAS maximum. If it becomes necessary to fly prolonged periods with gear extended, flight shall be limited to 275 KCAS at 1G.

DRAG CHUTE.

Drag chute deployment limitation is 200 KCAS maximum.

RAM AIR TURBINE.

Ram air turbine extension limitations.

1. Below 20,000 feet, 575 KCAS maximum.
2. Above 20,000 feet, Mach 1.3 maximum.

REFUELING PROBE.

Air refueling probe extension limitations, 400 KCAS maximum.

TRAILING EDGE FLAPS.

1. Trailing edge flaps extended 100 percent, 275 KCAS maximum.
2. Operation of more than two complete cycles (one cycle being from full UP to full DOWN and return to full UP) of the trailing edge flaps in any 30-minute period during flight should be avoided. (Insufficient cooling time for the electric actuators will shorten their total life.)
3. When reversing the motion of the flaps, a delay of approximately 5 seconds should be observed. (Sudden reversal of flap operation will overload and burn out the current limiting fuses.)

LEADING EDGE FLAPS.

1. Leading edge flaps extended more than 40 percent, 500 KCAS maximum.
2. Leading edge flaps extended from 0 to 40 percent, 730 KCAS maximum.

VARIABLE AIR INLET SYSTEM.

For maximum speed limitations with variable air inlet system inoperative, refer to figure 5-4.

CANOPY SPEED RESTRICTIONS.

1. Canopy operation, open or closed at taxi speeds up to 40 knots relative wind, is limited to the range between fully closed to 15 degrees open.
2. Canopy operation, open or close beyond the 15-degree position, must be accomplished with the aircraft stopped.
3. **[D]** Aircraft may be taxied with the canopy in any static position between fully open to fully closed at relative wind speeds up to 65 knots.
4. **[F]** Aircraft may be taxied with the canopy in any static position between 55 degrees open to fully closed at relative wind speeds up to 50 knots; at positions above 55 degrees, the open canopy is affected by side loads that may result in excessive hinge mechanism wear and failure.

BARRIER ENGAGEMENTS.

Mid-field and approach end engagements of any barrier should not be attempted.

Note

Barrier cables may be damaged to the point of failure by the rims of aircraft wheels. When suspected tire failure occurs, pilots should consider releasing the brakes when sliding over barrier cables. This will reduce the amount of damage to the cable, and brakes can be re-applied when the aircraft wheels have passed over the cable.

BRAKE AND TIRE LIMITATIONS.

When the tires of an aircraft become overheated from taxiing, or from heavy braking, they may disintegrate with explosive violence, often accompanied by fire. When tires and brake housings become heated to the point where a hand cannot be held on them, further operations should be suspended until the heat has dissipated. Cooling time will vary, depending on ambient conditions, and may take up to 3 hours. When heat builds up from extended taxiing or prolonged application of light braking during

taxiing or landing, delay subsequent operation until the hand can be held on the tire and brake housing.

Note

Taxi distances of 15,000 feet will produce heat in this area.

Figure 5-3 should be used to determine the cooling period necessary before subsequent operation as follows:

1. If braking falls in the DANGER zone:
 - a. If possible, taxi aircraft clear of runway, other aircraft, and personnel. This distance should be held to an absolute minimum.
 - b. Request firefighting equipment as tire blow-out and fire are imminent.
 - c. Evacuate aircraft and leave the vicinity immediately.

WARNING

Keep forward of aircraft.

2. If braking falls in the WARNING zone:
 - a. Tire blowout and fire are possible, proceed as for danger zone.
3. If braking falls in CAUTION zone:
 - a. Delay subsequent takeoff by the amount of time indicated and your hand can be held on tires and brake housing.
4. If stop falls below the CAUTION zone:
 - a. Subsequent takeoffs can be made providing the hand can be held against the tire and brake housing and total taxi distance will not exceed 15,000 feet.

PROHIBITED MANEUVERS.

1. Intentional spins are prohibited.
2. Any maneuver resulting in negative G loads exceeding 2 seconds, should be avoided as engine flame-out will result. If the oil pressure drops

BRAKE COOLING REQUIREMENTS

NORMAL

Subsequent takeoffs can be made provided hand can be held against tire and brake housing, and taxi distance is less than 15000 feet.

CAUTION

Delay subsequent takeoff for required cooling time and until hand can be held against brake housing and taxi distance is less than 1500 feet.

WARNING

**TIRE BLOWOUT
AND FIRE
POSSIBLE**

Request fire-fighting equipment. If possible, taxi minimum distance clear of runway, other aircraft and personnel. EVACUATE AIRCRAFT, KEEP FORWARD OF AIRCRAFT. Leave vicinity immediately.

DANGER

**TIRE BLOWOUT
AND FIRE
IMMINENT**

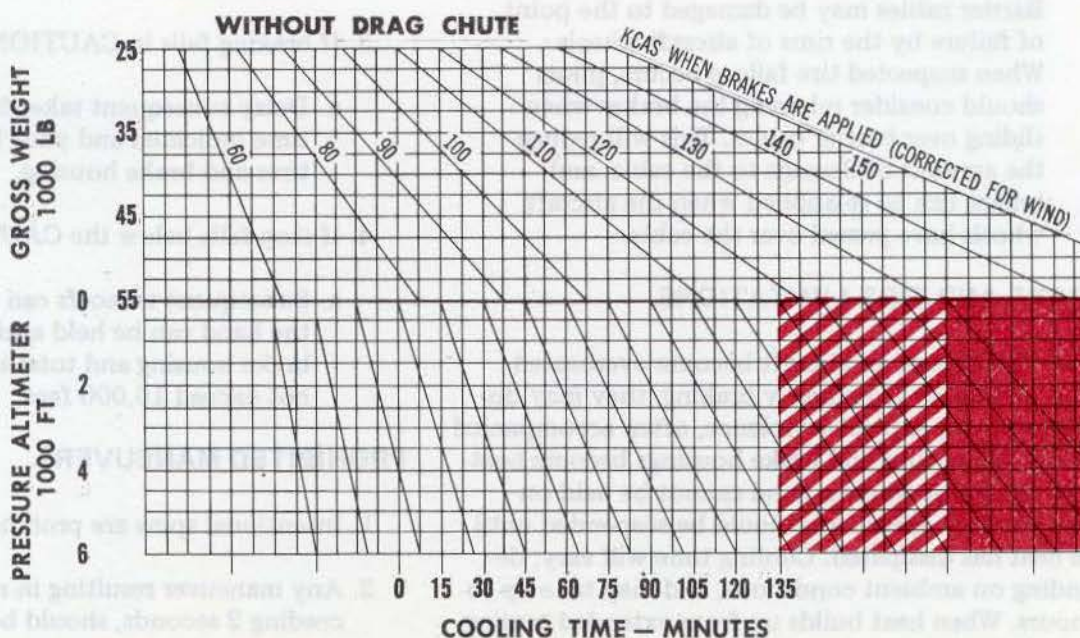
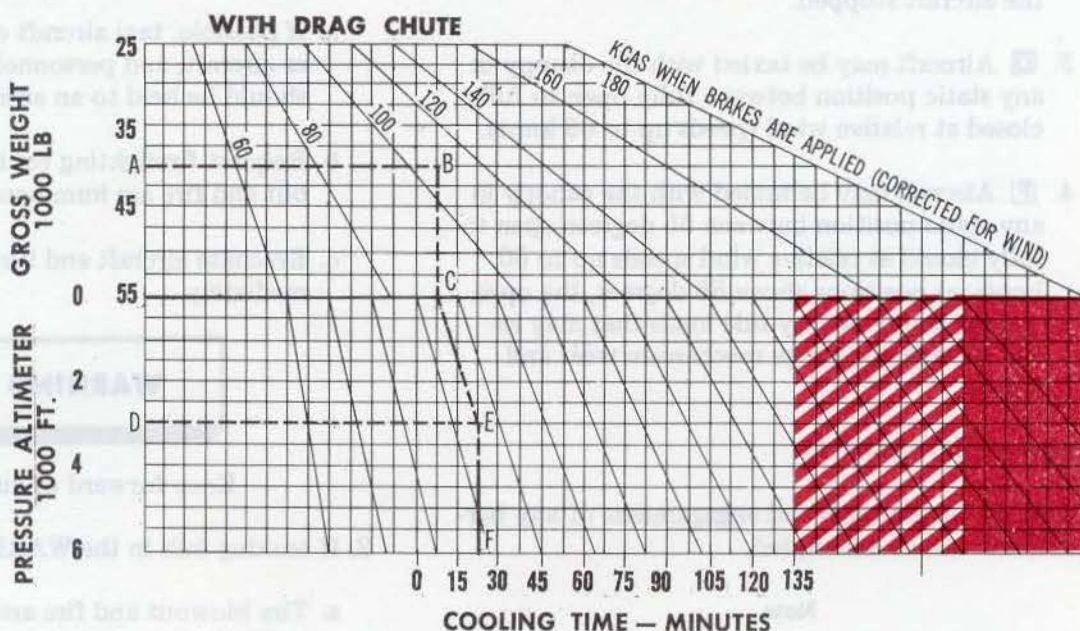


Figure 5-3

to zero during this period, or if the time limit is exceeded, an entry will be made on AFTO Form 781.

3. During A/B operation, intentional negative G maneuvers should be avoided.

ROLL RESTRICTIONS.

Roll is a rotation about the aircraft longitudinal axis.

1. Full lateral stick rolls are permitted at all speeds, but below 350 KCAS use reduced lateral stick deflection when rolling beyond 180-degree bank angle.
2. In full lateral stick rolling pushovers (less than 1G) above 600 KCAS, avoid using additional forward stick while rolling. Do not continue rolls of this type beyond 360 degrees.
3. Negative G loads are not permitted during roll maneuvers.
4. High roll rates are attainable with external stores installed. Therefore, the roll rate limits of figure 5-5, with external stores can readily be exceeded with moderate stick deflections during rolling maneuvers. With full tanks or heavy stores, the initial roll response is reduced from that of the clean aircraft, but the attainable roll rate is not. The pylon load limit can be readily exceeded due to high centrifugal force from excessive roll rate with a heavy store. For example, with full or partial fuel in external fuel tanks, the limit roll rate can be reached in 30-degree bank angle with full stick deflection or in 60-degree with one-half (3-inch) stick deflection. Large initial deflection should therefore be promptly reduced when rolling more than 30 to 45 degrees, and initial deflections of more than one-half stick avoided. Intentional 360-degree rolls with heavy stores should not be performed.

CAUTION

Failure to observe the roll rate limits may result in structural failure of the wing-pylon attachment.

ACCELERATION LIMITATIONS.

The G limits for a clean aircraft with bomb bay tank installed and released for restricted flight by T.O. 1F-105-1085C and T.O. 1F-105-1090, will be 5.5 G's subsonic and 4.5 G's supersonic. When external stores are carried, the presently authorized G limits will be reduced by a factor of 0.75 for

subsonic flight and by 0.61 for supersonic flight. (Example: If a G limit for subsonic flight with a certain store was 5 G's, the new G limit will be 5×0.75 equals 3.75 G's.)

For Acceleration Limitations refer to figure 5-5.

FLAP TRIM TAB RESTRICTIONS.

Aircraft with trailing edge flap trim tabs will not be flown with the trim tabs deflected. The trim tabs have been deactivated and should not be deflected.

AUTOPILOT RESTRICTIONS.

1. Stab-aug will not be engaged or reengaged in flight unless controls are trimmed, attitude is stabilized and altitude is such that a recovery could be made if a malfunction occurs.
2. Automatic ILS approaches are limited to 200 feet (or published minimums, whichever is greater).

BOMB-BAY DOOR RESTRICTIONS.

1. Opening doors — 0 to 3G.
2. Doors open — 0 to 5.3G.
3. The duration of flight time, with the doors open, will be kept to a minimum (time not to exceed 4 minutes for any single operation). Total (cumulative) open time shall not exceed 15 minutes in any one flight.
4. Do not open doors in flight with bomb-bay fuel tank installed.

GUN FIRING LIMITS.

To prevent damage to the M-61 20 MM gun, firing should be limited to bursts of no longer than 2½ seconds duration with a 1-minute cooling period between each burst.

GUNNERY TOW SYSTEMS.

A/A37U-9 TOW SYSTEM.

The following restrictions apply for the A/A37U-9 gunnery tow system utilizing the TDU10/B Dart Target:

1. With target in stowed position on aircraft:
 - a. Maximum speed 270 KCAS.

AIRCRAFT RESTRICTIONS

with VAI inoperative

PLUGS FULL AFT — BLEED DOORS FULL CLOSED

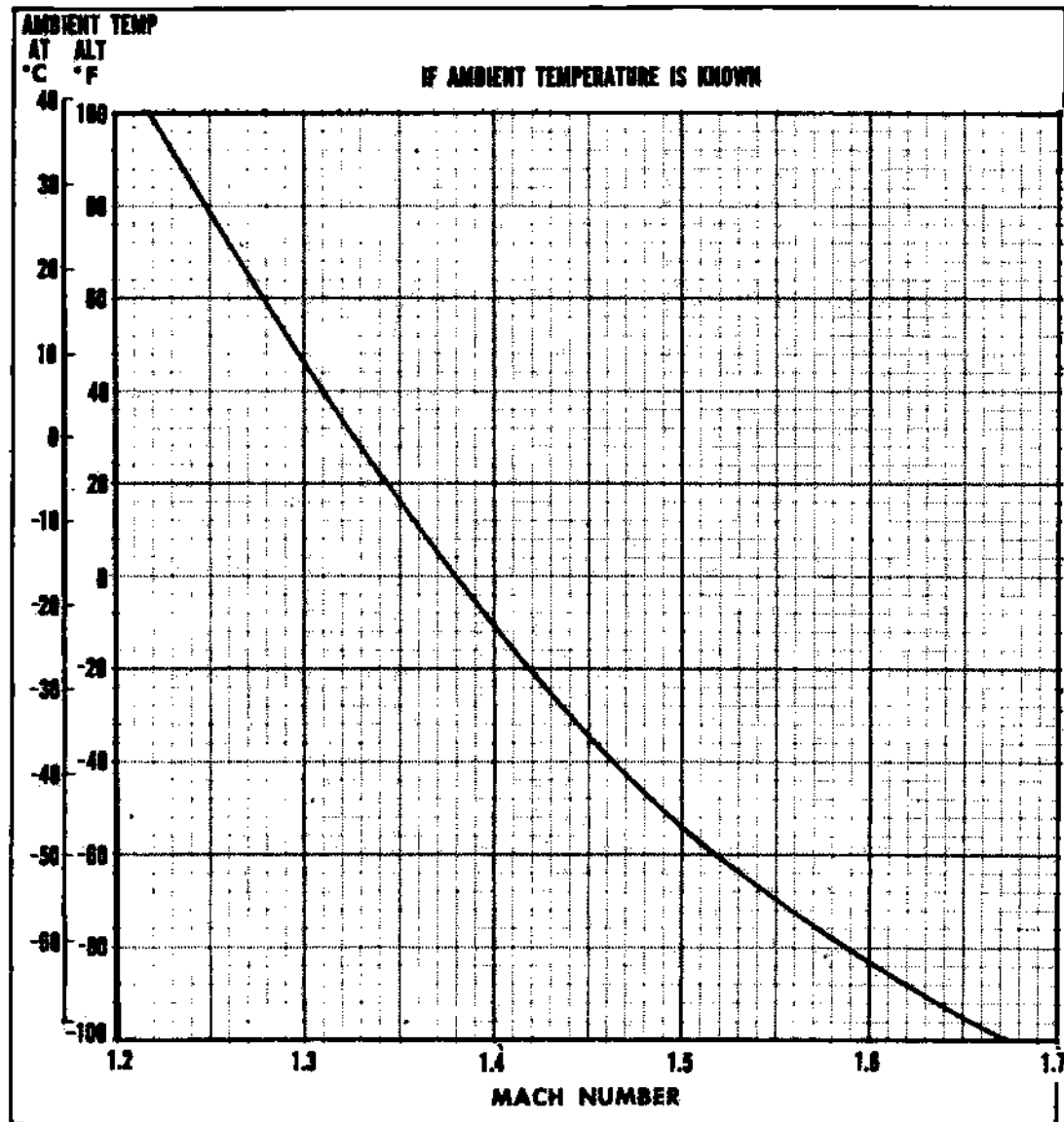
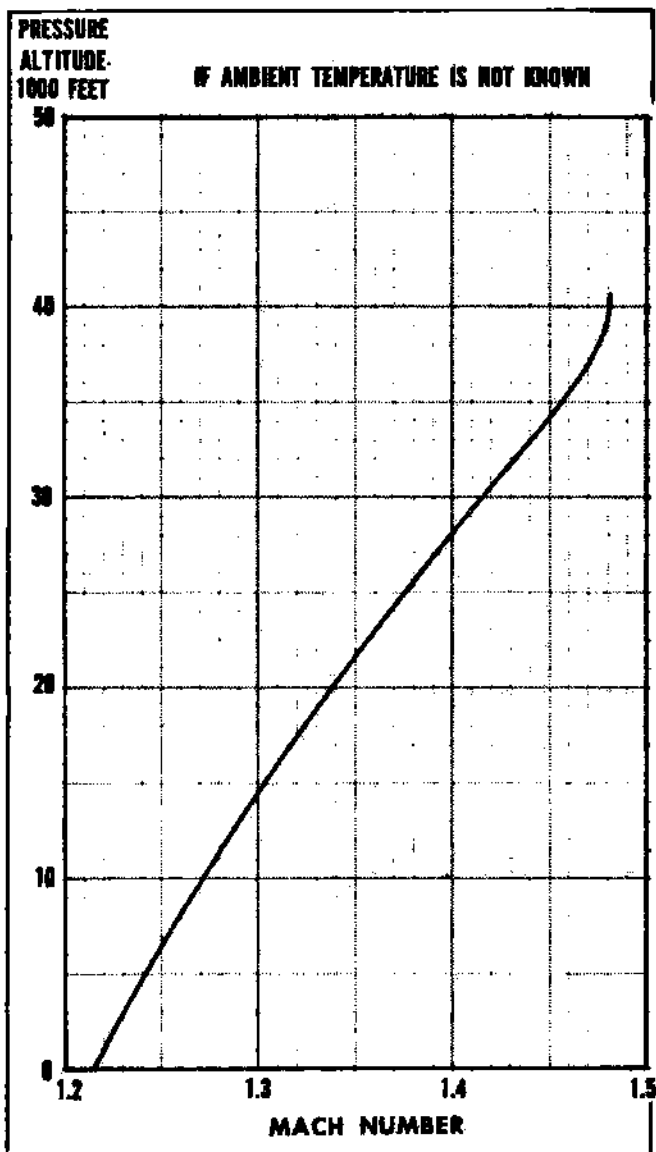


Figure 5-4

- b. No violent maneuvers.
- c. Plus 2G maximum.
- 2. During target launching:
 - a. Maximum speed 190 KCAS until cable out light illuminates (approximately 2½ minutes).
 - b. Minimum altitude 1000 feet.
- 3. During target in tow position:
 - a. Maximum speed 475 KCAS or 1.1 Mach.
 - b. Plus 2.5G maximum.
 - c. Minimum altitude 1000 feet.
 - d. Maximum altitude 2000 feet for target recovery.
- 4. After target recovery:
 - a. 1.3 Mach maximum.
 - b. Plus 4G maximum.
- b. Acceleration +2.5G maximum.
- c. Minimum altitude 1000 feet.
- d. Speed for target recovery 200 KCAS, 50 percent TE flaps.
- e. Maximum altitude for recovery 2000 feet.
- 4. After target recovery:
 - a. Maximum speeds 450 KCAS or Mach 1.1, whichever is lower.
 - b. Acceleration +4G maximum.
- 5. If cable cannot be cut proceed as follows: Establish a 10 degree dive angle at 300 KCAS, approximately 800 feet above ground, effect pullout to impact the target with the ground, land 1500 — 2000 feet long on the runway as the cable will be trailing. Do not proceed down the taxiway until ground crews have dismembered the cable.

A37U-15 TOW SYSTEM.

The following restrictions apply for the A/A37U-15 gunnery tow system: (Increase lift off 10 KCAS above computed airspeed for aircraft gross weight.)

- 1. With target in stowed position.
 - a. Maximum speed 350 KCAS.
 - b. No violent maneuvers.
 - c. Acceleration +1.5G maximum.
- 2. During target launching:
 - a. Establish straight and level flight.
 - b. Launch speed 220 KCAS. (For altitudes above 15,000 feet, launch speed will be 250 KCAS utilizing 50 percent trailing edge flaps.)
 - c. Minimum launch altitude 1000 feet.
 - d. Leading edge flaps only.
- 3. During target in tow position:
 - a. Maximum speed 450 KCAS or Mach 1.1, whichever is lower.

AIR REFUELING RESTRICTIONS.

- 1. Air refueling with A/B in extended A/B range is limited to between 15,000 and 38,000 feet. See extended afterburner range limits.

CENTER OF GRAVITY LIMITATIONS.

- 1. The numerous combinations of external stores that can be carried may result in the CG exceeding the aft allowable limit. Permissible CG movement can be expressed in inches from the reference datum or in percent MAC (mean aerodynamic chord) from the leading edge of the MAC. Mean aerodynamic chord is the chord of an imaginary airfoil which represents the vector sum of the actual wing. Permissible CG travel is as follows:
 - ☐ 18 to 35 percent MAC.
 - ☐ 13.7 to 28.5 percent MAC.

Each configuration should be examined before flight; if it is found that inflight CG movement goes beyond the desired limits, fuel system management

in accordance with section VII and/or off-loading of weapons will be necessary. Refer to T.O. 1F-105D-5 or 1F-105F-5 for further information.

- The weight and CG obtained from the Weight and Balance Clearance Form F gives the CG with landing gear down at takeoff weight. During a mission the following changes to the CG may take place.

<i>Approximate CG Movement, per cent MAC</i>	D	F
Bomb Bay Tank, 390 Gal to empty	<i>Aft 2.5</i>	<i>Aft 2.0</i>
Centerline Pylon, maximum 6 x 750 lbs bombs released from MER	<i>Aft 2.3</i>	<i>Aft 1.8</i>
Ammunition Drum, full to fired	<i>Aft 2.0</i>	<i>Aft 2.0</i>
Centerline (Belly) Tank, 650 Gal to empty	<i>Aft 1.6</i>	<i>Fwd 0.8</i>
Internal Fuel		
D Full to 5000 lbs remaining 5000 to 1800 lbs remaining	<i>Aft 0.8</i> <i>Fwd 1.7</i>	
F Full to 5740 lbs remaining 5740 to 1800 lbs remaining		<i>Aft 2.6</i> <i>Fwd 4.2</i>
Gear down to up	<i>Fwd 1.0</i>	<i>Fwd 1.0</i>
Outboard Pylons, maximum 1500 lbs bombs released	<i>Fwd 2.2</i>	<i>Fwd 2.2</i>
Wing Pylon Tanks (2), 900 Gal to empty	<i>Fwd 3.5</i>	<i>Fwd 4.4</i>
Inboard Pylons, maximum 8 x 750 lbs bombs released from MER	<i>Fwd 4.7</i>	<i>Fwd 5.6</i>
Inboard Pylons, maximum 2 x 3000 lbs bombs released from pylon	<i>Fwd 5.0</i>	<i>Fwd 5.9</i>

- There is no way of controlling the internal fuel distribution when partially filling the fuel tanks with the single-point refueling equipment. Therefore, all the internal fuel tanks, except the bomb bay tank, must be full before takeoff.
- Abnormal internal fuel distribution caused by improper fuel system management, or inopera-

tive fuel tank boost pumps, may result in exceeding the forward, or aft, CG limits. If the forward, or aft, CG is exceeded, extreme caution should be exercised in landing.

- Where weapons are to be carried on more than one station, the following rule of thumb should be used: Load from centerline station out, and drop from outboard station in. In general the best balance will be achieved if external fuel is carried on the wing station rather than the fuselage centerline station.

650 GALLON CENTERLINE (BELLY) TANK RESTRICTIONS.

- Takeoff or touch-and-go landings with tank partially full is prohibited when operating with aircraft near the maximum allowable aft CG condition. Because of fuel displacement during aircraft acceleration the CG could shift as much as 2.6 percent MAC aft.
- Landing with tank partially full is permitted.
- Landing with tank full is limited to 240 FPM descent sink speed provided there is no other external fuel.

SUU-13/A DISPENSER RESTRICTIONS.

After a SUU-13/A Dispenser has been actuated, it must be ejected or jettisoned prior to landing. This is to preclude return to base of any non-ejected or partially ejected munition clusters.

WEIGHT LIMITATIONS

- Maximum gross weight for taxi and takeoff:

D 52,838 pounds.

F 54,580 pounds.

- Design normal landing gross weight which corresponds to maximum sink rate of 540 feet per minute or 9 feet per second is:

D 32,393 pounds

F 33,800 pounds

- Emergency landing gross weight (full internal plus bomb bay fuel) — Maximum sink speed of 360 feet per minute or 6 feet per second:

D 38,000 pounds

F 39,550 pounds

For landing gross weight between the design normal landing gross weight and the emergency landing gross weight subtract 30 feet per minute from 540 feet per minute for every 1000 pounds over ☐ 32,393 pounds or ☐ 33,800 pounds to arrive at a sink speed.

For any landing gross weight between the emergency landing gross weight and the maximum emergency landing gross weight subtract ☐ 14 feet per minute or ☐ 15 feet per minute from 360 feet per minute for every 1000 pounds over ☐ 38,000 pounds or ☐ 39,000 to arrive at a sink speed.

4. Maximum emergency landing gross weight (if unable to jettison external stores) — Maximum sink speed of 180 feet per minute, or 3 feet per second:

☐ 51,038 pounds

☐ 51,727 pounds

Note

All high gross weight emergency landings should use a very flat final approach and be made as gentle as possible. The above sink speeds are only provided as a guide to the maximum allowable sink speed, at touchdown and are not rates of descent during final approach. (AVVI vertical velocity should not be used to determine the sink speed).

EMERGENCY FLIGHT CONTROL SYSTEM [1045] C/W.

Maximum speed 0.85 Mach. (Lock engagements may be made at higher speeds but aircraft must be in a nose-up attitude and the speed must be reduced immediately. Do not use flaps until speed is reduced.)

Flap extension—Do not exceed 30 percent at speeds up to 0.85 Mach. Do not use flaps above 0.85 Mach.

Load factor — Do not exceed 2.0G.



Use of conventional lateral control system after engaging the emergency flight control system should be minimized to avoid overloading flaps and expending residual hydraulic fluid.

TAKEOFF RESTRICTIONS — MILITARY THRUST.

Takeoffs with military rated thrust under conditions which result in a predicted ground roll in excess of 7000 feet are prohibited. Under these conditions, the military thrust characteristics at lift off may result in marginal climbout capability.

ACCELERATION AND JETTISON LIMITATIONS

The load factor limitations given herein are 100 per cent of design limit except for the F-105F clean aircraft which is restricted to 80 percent of design limit. Where the load factor limitations for the store configurations exceed the F-105F clean aircraft values, presented herein the F-105F clean aircraft limits shall apply.

With abnormal internal fuel distribution the supersonic load factor shall be limited to that determined by the external store configuration, or 5.0 G, whichever is lower.

Subsonic speed is defined as speeds below Mach 0.9.

Supersonic speed is defined as speeds above Mach 1.0.

Speeds between Mach 0.9 and 1.0 the G limit will decrease linearly.

For weights greater than design weight, the load factors should be reduced so that the reduced load factor times the greater weight does not exceed the design load factor times the design weight.

ADDITIONAL LIMITATIONS

(A) Mixed Store Limits	Except for speed limits for wing mounted stores, are determined by reading the limits for each store alone and observing the more severe restriction. The speed limits listed in the table for wing mounted stores are for symmetric loading unless otherwise specified. For symmetric wing mounted store combinations not specifically listed in the table, the speed limit shall not exceed 500 KCAS. For asymmetric loading the speed limit for each wing combination should be treated as if it were symmetric and the more severe restriction of the two shall be observed.			
(B) Pylons and MA-2 Rocket Launchers	(F-105B adapters) without stores are not considered as stores when determining mixed store limits.			
(C) Unfinned Stores On Outboard Wing Stations	Have a more severe G restriction when inboard wing station is clean. Therefore if inboard stores are expended and outboard stores retained the G restrictions become more severe.			
(D) INTERNAL STORE or MN-1A BOMBLETS	Ejection limit +5.3G			
(E) LAU/3A, 18A, -32 or -59 (Rocket Pod)	Launching in salvo, load limit +1.0G			
(F) AIM-9-B (Sidewinder) with MK-8 warhead	Store Temperature	Speed Limit	Up to 10 MIN MAX, warhead inspection after flight	
	Below 10,000	500 KCAS	Below 10,000	550 KCAS
	Above 10,000	550 KCAS	10,000-25,000	600 KCAS
			Above 25,000	650 KCAS
	DO NOT EXCEED 550 KCAS WITH 450 GAL TANK INBOARD			
THE AIM-9B ADAPTER CANNOT BE JETTISONED. THE AIM-9B CANNOT BE JETTISONED. THE AIM-9B MAY BE LAUNCHED UNARMED.				

(G) AGM-12B (Bullpup)	Store temperature speed limit: Above 20,000 550 KCAS Below 20,000 450 KCAS	
Launching speed limit:		450 KCAS Below M 0.95
THE AGM-12B ADAPTER CANNOT BE JETTISONED. THE AGM-12B IS JETTISONED UP TO A SPEED OF 575 KCAS AND A SYMMETRIC LOAD FACTOR OF +4.0G.		
AGM-45A (Shrike)	Do not launch two missiles simultaneously from the aircraft. AGM-45A release circuits are selected by rotating the weapons selector switch to CONVENTIONAL BOMBS and the pylon sequence selector switch to SINGLE SEQUENCE. Only one station selector switch shall be engaged at a time because if LO and RO station selector switches are engaged prior to launch, the left missile tone and firing circuits are selected, but the attitude director indicator will respond to signals from the right missile.	
AGM-78	If the LAU-78 is employed with the AGM-78A or AGM-78B, the lower flight limits in figure 5-5 apply. If the LAU-80 launcher is used with the AGM-78A or AGM-78B, the higher limits in figure 5-5 apply.	
C/B Munitions	After dispensing C/B munitions, or in the event of aircraft contamination from C/B munitions, the pilot will request the tower to prepare for isolated parking. At the same time, he will provide the unclassified designator of the agent.	
CBU-46/A	The inboard 450 gallon tank may be superficially damaged upon salvo dispensing. This should not limit the operational use of this munition.	
(H) M-117 (Bomb) with M-131A1 Fins	MAXIMUM SPEED IS 500 KCAS. AT HIGHER SPEEDS BOMB FIN DISINTEGRATION IS PROBABLE.	

Figure 5-5 (Sheet 1 of 22)

VT 188 (Fuse)	MAXIMUM SPEED FOR CARRIAGE AT ALL STATIONS IS 600 KCAS. THE ARMING WIRE IS RETAINED WITH THE AIRCRAFT AFTER BOMB DELIVERY. THE ARMING WIRE SHOULD BE RELEASED TO PREVENT AIRCRAFT DAMAGE.
J M-117R (Bomb)	LIMITS APPLICABLE TO STRAIGHT LEVEL FLIGHT AND DIVES UP TO 30 DEGREES AND APPLY TO HIGH OR LOW DRAG CONFIGURATION.
*M-117 GP Bomb W/M1A1 Fuze Extender	Flight limits and drag numbers are the same as M-117. The maximum airspeed is 500 KCAS for all configurations. This is a fuze extended limitation.
SUU-13/A Dispenser	After an SUU-13/A dispenser has been actuated, it must be ejected or jettisoned prior to landing. This is to preclude return to base of any non-ejected or partially ejected munition clusters.
MK-82 Fuze Extender	The M1A1 fuze extender may be any length not greater than 36 inches. "Thick" or "thin" walled extenders may be used. The aluminum lanyard guide tube must be used.

K WARNING

The following apply to use of the BLU-52/B bomb in any configuration.

- The BLU-52/B bomb must be expended (ejected or jettisoned) once it is airborne. If, for any reason, it cannot be delivered to the original or alternate target, it must be released over designated hostile territory or over designated uninhabitable territory at least five miles from the nearest habitable site. Preferred sites will be selected by the local commander.
- Aircrew members, on aircraft going to or near (within five miles and below 5000 feet AGL) a target area already hit, or about to be hit by BLU-52/B bombs, must have adequate protection for the eyes and respiratory system. Gloves should be worn and all exposed areas of the skin should be covered.
- Aircraft carrying the BLU-52/B bomb should be the last to take off and the last to approach a target area. All other aircraft should evacuate to a distance of at least five miles while the BLU-52/B bombs are being delivered. Aircraft releasing the bombs should evacuate the target area as soon as possible and remain at least five miles from the target or above 5000 feet AGL.
- High explosive detonations in an area previously seeded by the BLU-52/B will require the same safety precautions as if BLU-52/B's were just dropped.

L Centerline MER Release Sequence A Sequence B

Center aft, Center forward, Left aft, Left forward, Right aft and Right forward.
Center aft, Left aft, Right aft, Center forward, Left forward and Right forward.

CAUTION: Certain combinations of external stores may exceed CG limitations. See CG limitations.

	CLEAN AIRCRAFT	MAX SPEED	SYMMETRIC LOAD G		ROLL LOAD G
D	NO INTERNAL STORE (Design Weight 34,058 Lb)	Below 23,000: 810 KCAS 23,000-35,000: Linearly increases, M 1.8 to M 2.1 Above 35,000: M 2.1	Subsonic	+8.67 -3.0	+6.1
	WITH INTERNAL STORE or bomb bay tank with fuel (Design Weight 36,018 Lb) [Ⓓ]	Same as above	Supersonic	+7.33 -3.0	+5.2
F	NO INTERNAL STORE (Design Weight 35,812 Lb)	Below 23,000: 810 KCAS 23,000-35,000: Linearly increases, M 1.8 to M 2.1 Above 35,000: M 2.1	Subsonic	+7.0 -2.5	+3.0
	WITH INTERNAL STORE or bomb bay tank with fuel (Design Weight 37,772 Lb) [Ⓓ]	Same as above	Supersonic	+5.5 -2.5	+3.0

EXTERNAL FUEL TANKS

Tanks cannot be ejected simultaneously with other stores without special effort on the part of the pilot. Therefore salvo limits are not provided for this case.

T.O. 1F-105D-1

EXTERNAL FUEL TANKS				CARRY					EJECT NON INTEGRAL TANK FROM PYLON		JETTISON PYLON WITH TANK				
CENTER LINE	INBD	OUTBD		MAX SPEED KCAS	SYMMETRIC LOAD G		ROLL LOAD G	RATE OF ROLL °/sec	MAX SPEED KCAS	SINGLE OR SYM PAIRS MAX G	MAX SPEED KCAS	MAX G			
450 or 650 GAL TANK			Empty	600 or M 1.3	+6.0	-2.5	+3.0	80 Not to exceed a roll angle of 180°	Not Applicable		Inbd 580 Center Line 450	+2.0			
			With Fuel	600 or M 0.95	+4.0	-2.0	+3.0	Unlimited							
450 or 650 GAL TANK	450 GAL TANK		Empty Above 15,000	600 or M 1.3	+5.0	-2.5	+3.0	80 Not to exceed a roll angle of 180°	600	+2.0	Do not jettison 650 gal tank while descending.				
			Empty Below 15,000	600 or M 1.3	+6.0	-2.5	+1.0	Unlimited							
			With Fuel	600 or M 0.95	+4.0	-2.0	+3.0								
650 GAL TANK & B/B TANK	M-118 (Bomb) (See Note 1 thru 6)	QRC-160 -1, -2 or -8 and/or AIM-9B (Note 11)	C/L TANK Empty	525 or M 1.3 ②	+5.0	-2.5	+3.67	80	500 M-118 only	+4.0	350 M-118 500 QRC-160 450 C/L Tank				
			C/L TANK Full		+4.0	-2.0	+3.0								
	450 GAL TANK		Empty Above 15,000	600	+5.0	-3.0	+3.67	Unlimited			580				
			Empty Below 15,000		+6.0	-3.0	+4.33								
			With Fuel		+4.0	-2.0	+3.0						80		
	450 GAL TANK	QRC-160-1, -2 or -8 (Note 11)	Empty Above 15,000	600	+5.0	-3.0	+3.67	125	SAME AS CARRY SPEED	EMPTY: +5.0 WITH FUEL: +4.0	580				
			Empty Below 15,000		+6.0	-3.0	+4.33								
			With Fuel		+4.0	-2.0	+3.0						80		
		LAU-3/A, -18A -32 or -59 (Rocket Pod)	Empty Above 15,000	550	+5.0	-3.0	+3.67	125			Empty same as Carry Speed with Fuel 500				
			Empty Below 15,000		+6.0	-3.0	+4.33								
			With Fuel		+4.0	-2.0	+3.0	80							
		M-129 (Bomb)		550											
		MC-1 (Bomb)		525 ②	With Fuel		+4.0 -2.0 +3.0	80							
		M-117 (Bomb)			Tanks Empty										
		M-117R (Bomb)		525 (Below M1.2)	+5.0	-3.0	+3.67				350				
		M-117D (Destructor)													
		MA-2 (Rkt Launcher)			Empty Above 15,000	600	+5.0	-3.0	+3.67	125	600		+5.0 Empty +4.0 Fuel	Empty same as Carry Speed with Fuel 500	
					Empty Below 15,000		+6.0	-3.0	+4.33						
					With Fuel		+4.0	-2.0	+3.0	80					

Figure 5-5 (Sheet 3 of 22)

EXTERNAL FUEL TANKS (Cont)

Tanks cannot be ejected simultaneously with other stores without special effort on the part of the pilot. Therefore salvo limits are not provided for this case.

EXTERNAL FUEL TANKS				CARRY				EJECT NON INTEGRAL TANK FROM PYLON		JETTISON PYLON WITH TANK			
CENTER LINE	INBD	OUTBD		MAX SPEED KCAS	SYMMETRIC LOAD G		ROLL LOAD G	RATE OF ROLL °/sec	MAX SPEED KCAS	SINGLE OR SYM PAIRS MAX G	MAX SPEED KCAS	MAX G	
450 GAL TANK		AGM-12B (Bullpup)	Empty Above 20,000	550 ①	+5.0	-2.5	+3.67	80	SAME AS CARRY SPEED	EMPTY: +5.0 WITH FUEL: +4.0	Empty same as Carry Speed with Fuel 500	+2.0 G	
			Below 20,000	450 ②									
			With Fuel	Above 20,000	500	+4.0	-2.0						+3.0
				Below 20,000	450 ②								
		AGM-45A (Shrike)	Empty	500	+5.0	-2.5	+3.67	125					
			With Fuel		+4.0	-2.0	+3.0						
		AIM-9B (Sidewinder)	Empty Above 15,000	See store speed limit ③ above	+5.0	-3.0	+3.67						
			Below 15,000		+6.0	-3.0	+4.33						
			With Fuel		+4.0	-2.0	+3.0						
		MK-82 (Snakeye) (Note 7)	Empty	525	+5.0	-3.0	+3.67	80	High drag 500 (Subsonic) Low drag 525 (Below M1.2)		350		
			With Fuel		+4.0	-2.0	+3.0						
		MK-82 (531 lb. Bomb)	Empty	525	+5.0	-3.0	+3.67		Same as Carry Speed		+4.0 Empty +3.0 Fuel		500
			With Fuel		+4.0	-2.0	+3.0						
		MK-83	Empty	500 Below M 1.2	+4.0	-2.0	+3.0		+4.0 (Store only)	350	+1.5		
			With Fuel		+3.0	-1.0	+2.5						
		CBU-24A/B, -24/B, -24B/B, -29A/B, -29/B, -29B/B, -49A/B, -49/B, -49B/B, -53/B, -54/B	Empty		+4.0	-2.0	+3.0						
			With Fuel										
		AN/ALE-2	Empty	600	+5.0	-2.0	+3.0		550	AN/ALE-2 Full +4.0 AN/ALE-2 Not Full +2.0	400	+2.0	
			With Fuel		+4.0	-2.0							

Figure 5-5 (Sheet 4 of 22)

EXTERNAL FUEL TANKS (Cont)

Tanks cannot be ejected simultaneously with other stores without special effort on the part of the pilot. Therefore salvo limits are not provided for this case.

EXTERNAL FUEL TANKS				CARRY				DISPENSING		EJECT		JETTISON PYLON WITH STORE	
CENTER LINE	INBD	OUTBD		MAX SPEED KCAS	SYM LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G
	450 GAL TANK	CBU-7/A (Note 7)	Empty	525	+5.0-2.0	+3.67	80	525 (400 Min) (Note 8, 9)	+5.0	500 (350 Min)	+5.0	350	+2.0
			With Fuel		+4.0-2.0	+3.0			+4.0		+4.0		
		CBU-28/A or CBU-30/A (Note 7)	Empty	550	+5.0-3.0	+3.67		550 (Note 9, 10)	+5.0	500	+4.0		
			With Fuel		+4.0-2.0	+3.0			+4.0		+4.0		

- NOTES: 1. Fuel system management in accordance with Section VII will be used.
 2. M-118 bombs will be dropped prior to selecting bomb bay fuel.
 3. M-118 bomb may be carried on MWP or universal B/D pylon.
 4. Ammunition will not be used until M-118 bombs are dropped.
 5. Centerline tank may be retained when empty.
 6. Weight and balance clearance Form F is required for each aircraft loaded to fly these configurations.
 7. The outboard pylon must use the strengthened aft yaw pin AF P/N 62D7002-1.

8. Do not dispense below 200 feet AGL.
 9. Dispense at 0.1, 0.2, 0.3, 0.5 intervals only.
 10. For maximum CBU-30/A effectiveness, do not dispense at altitudes greater than 500 feet above ground level. This restriction applies to the CBU-30/A only.
 11. Stores on which compatibility (HERO) tests have been conducted which can be carried while operating the QRC-160-8 are as follows: Inboard and Centerline tanks, AIM-9/B, AGM-12/C and MK-36.

CONFIGURATION			CARRIAGE				DISPENSING	EJECTION			JETTISON
INBD	OUTBD	CENTERLINE	AIRPEED	SYM G	ROLL G	ROLL RATE		MODE	AIRPEED	SYM G	KCAS/SYM G
2 MK-82 (1 on outboard fwd shoulder and 1 on aft center).	1 MK-82 With M1A1 Fuse Extender.	650 Gallon Tank	500 Below 0.9M	Tank Empty +5.0, -2.5 Tank Full +4.0, -2.0	Empty +3.0 Full +2.67	80°/Sec	N/A	Single Dual Ripple	500 Below 0.9M	+2.0	275/+2.0 (Do not jettison 650 gallon tank while descending.)
	Other Stores (3)	Other Stores (3)		+5.0 -2.5	+3.0						

NOTES:

- The M1A1 fuze extender may be any length not greater than 36 inches and may be "thick" or "thin" walled. The aluminum guide tube assembly must be used.
- Outboard pylon must use the strengthened aft yaw pin (RAD SK79-75196).
- For mixed store limits see T.O. 1F-105D-1, Section V, Note A.
- Drag numbers are the same as the MK-82.

CENTERLINE MULTI EJECTOR RACK (MER)

STORES		CARRY				EJECT FROM MER			JETTISON PYLON & MER with or without stores or stores alone		
CENTERLINE PYLON		MAX SPEED KCAS	SYMMETRIC LOAD G		ROLL LOAD G	RATE OF ROLL"/SEC	EJECTION SEQUENCE	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G
PYLON and MER ONLY			Same as Clean				Not Applicable			600	
*4 M-117 or 4 MC-1 (Bombs) (upper location) (Bomb fins 45° to Vertical)		675 ^H (Below M 1.2)	+5.0	-2.5	+3.67	80	Single, Dual or Ripple	650 (Below M 1.2)	+3.0 Seq B ①	350 FULLY LOADED 225 PARTIAL LOAD Do not jettison partially loaded with TE flaps deflected	+2.0
*6 M-117 or 6 MC-1 (Bombs) Upper bomb fins 45° to Vertical Lower bomb fins vertical		600 ^H (Below M 1.2)	+4.0	-2.0	+2.5			Same as Carry Speed	+4.0 Seq A ①		
6 M-129 (T-58 Leaflet Bomb) { Upper bomb fins 45° to Vertical Lower bomb fins vertical		600 (Below M 1.2)	+6.0	-2.5	+4.33				+6.0		
3 M-117R (Bomb) { 2 Fwd upper location 1 Aft lower location ③							600 (Subsonic) 600 (Below 1.2) Low drag only	+4.0	225	Single, Dual or Ripple	Same as Carry Speed
3 M-117D (Destructor)											
3 M-117 (Bombs)* { Upper bomb fins 45° to Vertical Lower bomb fins vertical		600 ^H (Below M 1.2)	+3.0	-1.5	+2.0	80	Single, Dual or Ripple	Same as Carry Speed	+3.0	225 Do not Jettison with TE Flaps Deflected	+1.5
5 CBU-24A/B, -24/B, -24B/B, -29A/B, -29/B, -29B/B, -49A/B, -49/B, -49B/B, -53/B, -54/B a. Carriage on Fwd C/L location prohibited b. Carriage of CBU-24/B, -29/B on Fwd racks prohibited c. Mixed loads of CBU-24, -29 are authorized. (Seq. A or B) ①		600 (Below M 1.2)			+2.5						
4 CBU-24A/B, -24/B, -24B/B, -29A/B, -29/B, -29B/B, -49A/B, -49/B, -49B/B, -53/B, -54/B a. Carry on shoulder racks only b. Carriage of CBU-24/B, -29/B on Fwd racks prohibited c. Mixed loads of CBU-24, -29 are authorized. (Seq. A or B) ①		675 (Below M 1.2)			+4.0						

Figure 5-5 (Sheet 6 of 22)

CENTERLINE MULTI EJECTOR RACK (MER) (Cont)

Figure 5-5 (Sheet 7 of 22)

STORES	CARRY				EJECT FROM MER			JETTISON PYLON & MER with or without stores or stores alone				
CENTERLINE PYLON	MAX SPEED KCAS	SYMMETRIC LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	EJECTION SEQUENCE	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G			
6 MK-82 (Snakeye) Seq A only ①	675 (Below M 1.2)	+5.0 -2.5	+3.67	80	High Drag Single Only	High Drag 500 (Subsonic)	+4.0	350 Full load 225 Partial load	+2.0			
6 MK-82 (531 lb. Bomb) Seq A or Seq B ②										Low Drag Single Dual or Ripple	Low Drag 500 (Below M 1.2)	225
4 MK-82 (Snakeye)		+6.0 -2.5	+4.33									
3 MK-82 (Snakeye) { 2 Fwd upper location 1 Aft lower location												
4 MK-82 (531 lb. Bomb)												
3 MK-82 (531 lb. Bomb) { 2 Fwd upper location 1 Aft lower location	500 (1.2 M)	+5.0 -2.5	+3.67		Single Dual Ripple	500 (1.2 M)		350				
MER/MER Pylon 3 MK-82 with M1A1 (Two on fwd shoulder, one aft center) 2 MK-82 with M1A1 on fwd shoulder												
2 BLU-1 (Fire Bombs) without (2 Fwd upper location) fins, standard (Carriage on aft lower napalm mix location prohibited)					Single					375 (Below M 0.95)	+6.0	225
2 BLU-1 (Fire Bombs) with (2 Fwd upper location) SK43C560 fins, (Carriage on aft lower standard napalm mix location prohibited)					Single Seq A ① Single, Dual or Ripple Seq B ②							
3 BLU-31/B { 2 Fwd shoulders 1 Aft center					600 (Below M 1.2)					+6.0 -2.5	+4.33	Single Dual Ripple
2 BLU-52/B ③		550 (Below M 0.95)	+6.0			225						
3 MK-83 { 2 Fwd upper location 1 Aft lower location	600 (Below M 1.2)	+4.0 -2.0	+3.0		Single	600 (Below M 1.2)	+3.0	350 Fully loaded 225 Partial load	1.5			
MER W/6 MLU-32/B-99 Briteye Flares				550 Single Release Only		+1.0		Fully loaded MER 350 Partially loaded MER 325		+2.0		

*Note: Do not jettison with trailing edge flaps deflected

CENTERLINE MULTI-WEAPONS PYLON

(Figure 5-5 (Sheet 8 of 22))

STORES		CARRY				EJECT FROM MER			JETTISON PYLON & MER with or without stores or stores alone		
MER CARRIAGE		MAX SPEED KCAS	SYMMETRIC LOAD G		ROLL LOAD G	RATE OF ROLL°/SEC	EJECTION SEQUENCE	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G
Pylon and MER only			Same As Clean					Not Applicable		600	
*4 M-117 or 4 MK-1 (upper locations fins 45° to vertical)		500 KCAS 675 H (Below 1.2 M)	+5.0	-2.5	+3.67	80	Single Dual or Ripple	500 KCAS 650 (Below 1.2 M)	Seq AⓁ +4.0 Seq BⓁ +3.0	350 Fully Loaded 225 Partially Loaded	+2.0
4 M-129 (Leaflet Bombs)		600 (Below 1.2 M)	+6.0	-2.5	+4.33			600 (Below 1.2 M)	+6.0		
4 CBU-24A/B, -24/B, -24B/B, -29A/B, -29/B, -29B/B, -49A/B, -49/B, -49B/B, -53/B, -54/B a. Carriage of CBU-24/B, -29/B on Fwd racks prohibited b. Mixed loads of CBU-24, -29 are authorized. (Seq A or B)Ⓛ		675 (Below M 1.2)	+4.0	-2.0	+3.0			650 (Below M 1.2)	+3.0	225	+1.5
2 BLU-1/B Std. Fill With SK43C560 Fins							600 (Below M 0.95)				
2 BLU-1/B Std. Fill Without Fins		550 (Below M 0.95)	+6.0	-2.5	+4.33		Single	375 (Below M 0.95)	+6.0	225	+2.0
2 BLU-27/B (Fire Bomb) Finned Fwd upper positions		550 (Below M 0.95)					Single Dual or Ripple	550 (Below M 0.95)			
2 BLU-27/B (Fire Bomb) Unfinned Fwd upper positions			550 (Below M 0.95)	+5.0	-2.0		+3.5	Single Dual or Ripple Seq AⓁ Single Seq BⓁ	375 (Below M 0.95)	+2.0	
2 BLU-52/BⓈ Fwd upper positions only		600 (Below M 0.95)	+6.0	-2.5	+4.33		Single	550 (Below M 0.95)	+6.0		225

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CENTERLINE MULTI-WEAPONS PYLON (Cont)

STORES		CARRY				EJECT FROM MER			JETTISON PYLON & MER with or without stores or stores alone	
MER CARRIAGE		MAX SPEED KCAS	SYMMETRIC LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	EJECTION SEQUENCE	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G
SINGLE CARRIAGE CONVENTIONAL						EJECTION FROM MAU-12A/A JETTISON PYLON/MAU-12A/A with or without stores or stores alone				
SUU-21/A	Same as clean aircraft	+6.0	-2.5	+4.0	80	NOT APPLICABLE	400 (Below 1.2 M)	+6.0	350	+2.0
CBU-24A/B, -24/B, -24B/B, -29A/B, -29/B, -29B/B, -49A/B, -49/B, -49B/B, -53/B, -54/B	700 (Below 1.9 M)	+5.0	-2.5	+3.67			650 (Below M 1.9)	+3.0		+1.5
M-117 (Bomb)*	Same as (H) clean aircraft (Below 1.9 M)	+6.0	-2.5	+4.0			700 (Below 1.9 M)	Seq A (H) +6.0 Seq B (H) +3.0		+2.0
MK-84	600 (Below M 1.9) 550 with M-1 fuze extender	+5.0	-2.5	+3.67			600 (Below M 1.9) 550 with M-1 fuze extender	+3.0		
M-118		+4.0	-2.0	+3.0				+4.0		
BLU-1/B Std. Fill With SK43C560 Fins	700 (Below M 0.95)	+6.0	-2.5	+4.0			600 (Below M 0.95)	+6.0		
BLU-1/B Std. Fill Without Fins							500 (Below M 0.95)			
BLU-52/B(H)	600 (Below M 0.95)						550 (Below M 0.95)			

Figure 5-5 (Sheet 9 of 22)

SINGLE CARRIAGE SPECIAL WEAPONS						EJECTION FROM MAU-12A/A JETTISON PYLON/MAU-12A/A with or without stores or stores alone				
BDU-4/B MD-6 BDU-10/B BDU-8/B Long or Short Nose BDU-12/B BDU-19/B	(Or parent weapon) (Or parent weapon) (Or parent weapon)	Same as clean aircraft (Below 1.9 M)	+6.0 -2.5	+4.0	80	NOT APPLICABLE	700 (Below 1.9 M)	+6.0	350	+2.0

CENTERLINE MULTI-WEAPON PYLON (Cont)

STORES	CARRY				DISPENSING BOMBS		DISPENSING ROCKETS		EJECT	JETTISON	
	MAX SPEED KCAS	SYM LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G		MAX SPEED KCAS	MAX G
SUU-20/A (Training Dispenser) SUU-20/A(M) SUU-20A/A	750 (Below M1.5)	+4.0 -1.5	+3.0 -0.0	80	750 (Below M1.5)	+4.0 -0.0	N/A	N/A	N/A	350	+2.0 -0.0

STORES	CARRY				DISPENSING		EJECT		JETTISON PYLON WITH STORE	
	MAX SPEED KCAS	SYM LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G
CBU-7/A	600 (Below M 1.4)	+6.0 -2.0	+3.67	80	600 (400 Min) Note 1	+6.0	500 (350 Min)	+5.0	350	+2.0
CBU-28/A or CBU-30/A		+6.0 -3.0	+4.0		Same as carry speed Note 2		500 Full or Empty			

NOTE:

1. Do not dispense below 200 feet above ground level. Dispense at 0.1, 0.2, 0.3 or 0.5 second intervals only.
2. For maximum CBU-30/A effectiveness, do not dispense at altitudes greater than 500 feet above ground level. This restriction applies to the CBU-30/A only.

Figure 5-5 (Sheet 10 of 22)

INBOARD STATION — MULTIPLE EJECTOR RACK

INBOARD PYLON WITH MER	OUTBOARD PYLON	CARRY				EJECT FROM MER			JETTISON PYLON							
		MAX SPEED KCAS	SYM LOAD G		ROLL LOAD G	RATE OF ROLL°/SEC	EJECTION SEQUENCE	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G					
PYLON & MER ONLY		700	Same as Clean A/C				Not Applicable			600						
2 BLU-1 or M116A2 (Fire Bombs) With and without fins 1 fwd. upper location 1 aft lower location	Clean	600 (Below M 0.95)	+4.0	-2.0	+3.0	80	Single	600 With Fins	+2.0 G	Fully loaded 350 Partial load 275	DO NOT JETTISON MER FROM PYLON +2.0 G					
	Any Store	500 (Below M 0.95)					375 Without Fins									
2 M-117 or MC-1 (Bombs) Upper location	Clean or M-117 or MC-1	550 Ⓢ (Below M 1.2)	+5.0	-2.5	+3.67		SINGLE, DUAL OR RIPPLE	SAME AS CARRY SPEED Except full rocket pod 350								
	Any Other Store	500 (Below M 1.2)														
4 M-117 or MC-1 (Bombs)	Clean or M-117 or MC-1	550 Ⓢ (Below M 1.2)	+4.0	-2.0	+2.5											
	Any Other Store	500 (Below M 1.2)														
2 M-129 (T-58 Leaflet Bombs) Upper location	Clean or M-129 or QRC-160 -1, -2, or -8 (Note 6)	500 (Below M 0.9)	+5.0	-2.5	+3.67											
	Any Other Store	400 (Below M 0.9)														
4 M-129 (T-58 Leaflet Bombs)	Clean or M-129 or QRC-160 -1, -2, or -8 (Note 6)	500 (Below M 0.9)	+2.5													
	Any Other Store	400 (Below M 0.9)														
2 LAU-3/A, 18/A, -32, 59 (Rocket Pods) 1 fwd. upper location 1 fwd. lower location MWP B/D	Clean or LAU-3/A, 18/A, -32, -59 or QRC-160 -1, -2, or -8 (Note 6) Ⓢ	500 (Below M 0.9)	+4.0	-2.0	+3.0		SINGLE									
	Any Other Store	400 (Below M 0.9)														
	Clean or LAU-3/A, 18/A, -32, -59 or QRC-160 -1, -2, or -8 (Note 6) Ⓢ	450 (Below M 0.9)														
	Any Other Store	400 (Below M 0.9)														

Figure 5-5 (Sheet 11 of 22)

INBOARD STATION—MULTIPLE EJECTOR RACK (Cont)

INBOARD PYLON WITH MER	OUTBOARD PYLON	CARRY				EJECT FROM MER			JETTISON PYLON		
		MAX SPEED KCAS	SYM LOAD G	ROLL LOAD G	RATE OF ROLL°/SEC	EJECTION SEQUENCE	MAX SPEED KCAS	G MAX	MAX SPEED KCAS	MAX G	
4 CBU-24/B, -29/B, -49/B	MWP	550 (Below M 1.2)	+3.0	-1.5	+2.0	80	Single Dual or Ripple	Same as Carry Speed	+1.5	350 Full Load 275 Partial Load	+1.5
	B/D							500 (Below M 1.2)			
2 BLU-27/B Finned 1 fwd. upper location 1 aft lower location	MWP	550 (Below M 0.95)	+2.5	+2.5	Same as Carry Speed		275				
		500 (Below M 0.95)									
2 BLU-27/B Unfinned 1 fwd. upper location 1 aft lower location	MWP	550 (Below M 0.95)			375 (Below M 0.95)		350 (Below M 0.95)				
		500 (Below M 0.95)									
2 BLU-52/B Fwd. upper and aft lower racks only	MWP	500 (Below M 0.90)	+4.0	-2.5	+3.0		Single Dual or Ripple	Same as Carry Speed	350		
	B/D	450 (Below M 0.90)									
4 MK-82 (Snakeye) or 4 MK-82 (531 lb. bombs)	MWP	525 (Below M 1.2) (Note 2)	+5.0	-2.5	+3.67		High Drag Single only Low Drag Single, Dual or Ripple	High Drag 500 (Subsonic) Low Drag 500 (Below M 1.2) (Note 3)	+2.0	350 Full Load 275 with less than 4 Stores	+2.0
		500 (Below M 1.2) (Note 2)						High Drag 500 (Subsonic) Low Drag 500 (Below M 1.2) (Note 2)		275	
2 BLU-31/B 1 fwd. shoulder 1 aft center	Clean or any other authorized store See Sec. V NOTE A	550 (Below M 1.2)	+4.0	-2.0	+2.5	80	Single Dual Ripple	550 (Below M 1.2)	+2.0	225 Do not jet- tison with trailing edge flaps de- flected.	+2.0

Figure 5-5 (Sheet 12 of 22)

Change 2

5-25

T.O. 1F-105D-1

INBOARD STATION – MULTIPLE EJECTOR RACK (Cont)

INBOARD PYLON WITH MER	OUTBOARD PYLON	CARRY				EJECT FROM MER			JETTISON PYLON		
		MAX SPEED KCAS	SYM LOAD G		ROLL LOAD G	RATE OF ROLL °/SEC	EJECTION SEQUENCE	MAX SPEED KCAS	G MAX	MAX SPEED KCAS	MAX G
Less than 4 4 MK-82 (Snakeye) or Less than 4 MK-82 (531 lb. bombs)	MWP Clean or MK-82 (Snakeye) or MK-82 (531 lb. bomb) (Note 1) or QRC-160-1, -2, -8 (Note 6)	500* (Below M 0.9) (Note 2)	+5.0	-2.5	+3.67	80	High Drag Single only Low Drag Single Dual or Ripple	High Drag 500 (Below M 0.9) Low Drag 500 (Below M 0.9) (Note 2)	+2.0	275	+2.0
	MWP or B/D Any Other Certified Store	400 (Below M 0.9)						High Drag 400 (Below M 0.9) Low Drag 400 (Below M 0.9)			
2 MK-83 1 fwd. upper location MWP 1 aft lower location	MK-83	500 (Below M 1.2)	+4.0	-2.0	+3.0			500 (Below M 1.2)	+1.5	350 Full Load 275 Partial Load	+1.5

STORES		CARRY				DISPENSING		EJECT		JETTISON PYLON WITH STORE	
INBOARD PYLON	OUTBOARD PYLON	MAX SPEED KCAS	SYM LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G
Clean	CBU-7/A (Note 4)	600 (Below M 1.4)	+4.0 -2.0	+3.0	80	600 (400 Min) (Note 5)	+4.0	500 (350 Min)	+4.0	350	+2.0
With Store	CBU-7/A (Note 4)	500	+5.0 -2.0			500 (400 Min) (Note 5)	+5.0		+4.0 +2.0 with Store Inboard		

MWP — MULTI WEAPON PYLON — cast magnesium pylon, trailing edge swept AFT from wing to the store.

B/D — Universal B/D Pylon — built up pylon, trailing edge swept FWD from wing to store.

NOTES: 1. The outboard pylon must use the strengthened aft yaw pin AF P/N62D7002-1 for carriage of the MK-82S Snakeye and MK-82 low drag bombs.

2. All inboard station limits are for the multiple weapon pylon. For multi-carriage on B/D pylon (Inboard Universal) reduce limits by 50 KCAS.

3. For multi-carriage on B/D pylon (Inboard Universal) reduce limits by 25 KCAS.

4. The outboard pylon must use the strengthened aft yaw pin AF P/N62D7002-1.

5. Do not dispense below 200 feet above ground level. Dispense at 0.1, 0.2, 0.3 or 0.5 second intervals only.

6. Stores on which compatibility (HERO) tests have been conducted which can be carried while operating the QRC-160-8 are as follows: Inboard and centerline tanks, AIM-9/B, AGM-12/C and MK-36.

INBOARD STATIONS MULTI-WEAPON PYLON

Cast Magnesium Pylon, Trailing Edge
Swept AFT From Wing to Store

STORES		CARRY				EJECT FROM PYLONS			JETTISON PYLON WITH STORES						
INBOARD PYLON	OUTBOARD PYLON	MAX SPEED KCAS	SYMMETRIC LOAD G		ROLL LOAD G	RATE OF ROLL"/SEC	MAX SPEED KCAS	SALVO MAX G	SINGLE OR SYM PAIRS G	MAX SPEED KCAS	MAX G				
1 BLU-27/B (Finned)	Clean	600 (Below M 0.95)	+4.0	-2.0	+3.0	80	Same as Carry Speed	N/A	+4.0	350	+1.5				
Clean	1 BLU-27/B (Finned)	500 (Below M 0.95)						+3.0							
1 BLU-27/B (Finned)	1 BLU-27/B (Finned)	600 (Below M 0.95)					N/A								
1 BLU-27/B (Unfanned)	Clean	500 (Below M 0.95)					+3.0								
Clean	1 BLU-27/B (Unfanned)	500 (Below M 0.95)	+3.0	-2.0	+2.0		Same as Carry Speed	+3.0	+3.0	+5.0	Same as Carry Speed				
1 BLU-27/B (Unfanned)	1 BLU-27/B (Unfanned)	550 (Below M 0.95)	+4.0	-2.0	+3.0			+4.0							
Clean	1 BLU-52/B	600 (Below M 0.95)	+5.0	-2.5	+3.67		550 (Below M 0.95)	+4.0	Inboard Stores +5.0				For AGM-78A Same as Carry Speed For CBU-24/29 (B, A/B, B/B) 350		
1 BLU-52/B ® MWP or B/D Pylon	Clean or QRC-160 -1, -2 or -8 (Note 2)	450 Above 20000 ft 525													
AGM-78A (Symmetric)	Clean or AGM-45A	525 all altitudes					Same as Carry Speed	+5.0	+3.67	Same as Carry Speed	+5.0	Inboard Stores +5.0	For QRC Pods Outboard Below 20000 ft 450 Above 20000 ft 500 Inboard Plus Outbd Lowest of Above Limits		
AGM-78A and Clean (Asymmetric)	Clean or AGM-45A	500 Above 20000 ft 525													
AGM-78A (Asymmetric) with one CBU-24/29 (B, A/B, B/B) opposite	Clean	450 Above 20000 ft 525	Any combination of the following Symmetric or Asymmetric, AGM-45A CBU-24/29 (B, A/B, B/B) QRC-160-1, -2, -8 AIM-9/B												
AGM-78 Symmetric or Asymmetric with CBU-24/29 (B, A/B, B/B) opposite															

Figure 5-5 (Sheet 14 of 22)

Change 2

5-27

T.O. 1F-105D-1

INBOARD STATIONS MULTI-WEAPON PYLON (Cont)

Cast Magnesium Pylon, Trailing Edge
Swept AFT From Wing to Store

T.O. 1F-105D-1

STORES		CARRY				EJECT FROM PYLONS			JETTISON PYLON WITH STORES	
INBOARD PYLON	OUTBOARD PYLON	MAX SPEED KCAS	SYMMETRIC LOAD G	ROLL LOAD G	RATE OF ROLL°/SEC	MAX SPEED KCAS	SALVO MAX G	SINGLE OR SYM PAIRS G	MAX SPEED KCAS	MAX G
AGM-78A and 450 gal tank (Asymmetric)	Clean or AGM-45A (See Note A for mixed store limits)	Below 20000 ft Tank W/Fuel 450	Tank Empty +5.0 -2.5	Tank Empty +3.67	80	same as Carry Speed		Tank Empty +5.0	same as Carry Speed	+2.0
		Tank Empty 525	Tank with Fuel +4.0 -2.0	Tank W/ Fuel +3.0				Tank W/Fuel +4.0		
		Tank not empty or AGM-78A opposite								
		Sea level to 5,000 ft — 475								
		5,000 to 15,000 ft — 450								
15,000 to 20,000 ft — 475										
Above 20,000 ft — 525										
All altitudes are MSL.										
AGM-78B (Mod 1) Symmetric Notes 1, 2, 3	Clean	525 Below 10,000 550 Above 10,000	+5.0 -2.5	+3.67				+5.0		
AGM-78B (Mod 1) Asymmetric with clean opposite Notes 1, 2, 3	Clean	550								
AGM-78B (Mod 1) Symmetric Notes 1, 2, 3	AGM-45 on both pylons	500 Below 20,000 525 Above 20,000								
AGM-78B (Mod 1) Asymmetric with 450 GAL TANK Notes 1, 2, 3	Clean	With Fuel 525 Below 10,000	+4.0 -2.0	+3.0		AGM-78B Same as carry speed		AGM-78B +4.0	AGM-78B Same as carry speed	+2.0
		Empty 550 Above 10,000	+5.0 -2.5	+3.67			AGM-78B +5.0			
AGM-78B (Mod 1) Asymmetric with 450 GAL TANK Notes 1, 2, 3	AGM-45 on both pylons	500 Below 20,000 525 Above 20,000	+5.0 -2.5	+3.67		Same as carry speed		+5.0	Same as carry speed	+2.0

Notes 1 Load factor are 100% design limit.

2 Launcher adapter will not be separated from MWP in flight

3 Modified Launcher/adaptor used.

CONFIGURATION (See Note A)		CARRY				EJECT			JETTISON	
INBOARD	OUTBOARD	MAX SPEED KCAS	SYM LOAD G	ROLL LOAD G	RATE OF ROLL %/SEC	MODE	MAX SPEED KCAS	SYM LOAD G	MAX SPEED KCAS	SYM LOAD G
AGM-78	Clean or QRC-160-1, -2, -8 or QRC-335	525 Below 10,000	+5.0 -2.5	+3.67	80	Single	Same as CARRY	+5.0	350	+2.0
		550 Above 10,000								
AGM-78	AGM-45	500 Below 20,000								
		525 Above 20,000								
AGM-78	Other authorized store ①	500								
AGM-78 Asymmetric with Clean opposite	Clean or AGM-45 QRC-160-1, -2, -8 or QRC-335	550								

Figure 5-5 (Sheet 16 of 22)

INBOARD PYLON	OPPOSITE PYLON		SPECIAL WEAPONS ASYMMETRICAL CARRIAGE									
1 BDU-8/B (Long Nose) 1 BDU-8/B (Short Nose) 1 MD-6 1 BDU-4/B 1 BDU-19B With or without ballast or parent weapons	Clean		650 (Below M 1.2)	+5.3	-2.5	+3.67	80	Same as Carry Speed	+4.0	With Store Outboard: +4.0 G With clean outboard: +4.0 G with fuel in tank +5.3 G with empty tank	350	+2.0
1 BDU-8/B (Long Nose) 1 BDU-8/B (Short Nose) 1 MD-6 With or without ballast or parent weapons	450 Gal Tank	With Fuel	575 or 0.9 M which- ever is higher	+4.0	-2.0	+3.0						
		Empty	600 (Below M 1.2)	+5.3	-2.5	+3.67						
1 BDU-19B 1 BDU-4/B With or without ballast or parent weapons	450 Gal Tank	With Fuel	600 (Below M 1.2)	+4.0	-2.0	+3.0						
		Empty	600 (Below M 1.2)	+5.3	-2.5	+3.67						

T.O. 1F-105D-1

INBOARD STATIONS MULTI-WEAPON PYLON (Cont)

Cast Magnesium Pylon, Trailing Edge
Swept AFT From Wing to Store

STORES		CARRY				EJECT FROM PYLONS			JETTISON PYLON WITH STORES	
INBOARD PYLON	OUTBOARD PYLON	MAX SPEED KCAS	SYMMETRIC LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	SALVO MAX G	SINGLE OR SYM PAIRS G	MAX SPEED KCAS	MAX G
SYMMETRICAL CARRIAGE INBOARD — ASYMMETRICAL/SYMMETRICAL CARRIAGE OUTBOARD										
INBOARD PYLON	OUTBOARD PYLON									
2 BDU-8/B (Long Nose) (Ballasted to parent weapon or parent weapons)	Clean or 1 QRC-160 or 2 QRC-160-1, -2 or -8 (Note 2)	575 or 0.9 M whichever is higher (Below M 1.2)	+5.3 -2.5	+3.67	80	Same as Carry Speed	+4.0	Outboard Clean: 5.3 G With Outboard Store: 4.0 G	350	+2.0
2 BDU-8/B (Long Nose) (Unballasted practice shape)	2 QRC-160-1, -2 or -8 (Note 2)	550 (Below M 1.2)								
	Clean or 1 QRC-160-1, -2 or -8 (Note 2)	510 (Below M 1.2)								
2 BDU-8/B (Short Nose, or parent weapons)	2 QRC-160-1, -2 or -8 (Note 2)	550 (Below M 1.2)								
	Clean or 1 QRC-160-1, -2 or -8 (Note 2)	500 (Below M 1.2)								
2 BDU-4/B or parent weapons	Clean or 1 QRC-160 or 2 QRC-160-1, -2 or -8 (Note 2)	600 (Below M 1.2)								
2 MD-6 or parent weapons	Clean or 1 QRC-160 or 2 QRC-160-1, -2 or -8 (Note 2)	550 (Below M 1.2)								
2 BDU-19B or parent weapons	Clean	650								
	1 QRC-160 or 2 QRC-160-1, -2 or -8 (Note 2)	600								

NOTES: 1. All above limits are applicable when QRC is also carried outboard both asymmetric and symmetric except with BDU-19B and parent weapon where carry speed is limited to 600 KCAS.

2. Stores on which compatibility (HERO) tests have been conducted which can be carried while operating the QRC-160-8 are as follows: Inboard and centerline tanks, AIM-9/B, AGM-12/C, and MK-36.

Figure 5-5 (Sheet 17 of 22)

INBOARD STATIONS MULTI-WEAPON PYLON (cont)

STORES		CARRY				DISPENSING BOMBS		DISPENSING ROCKETS		EJECTION	JETTISON	
INBOARD PYLON	OUTBOARD PYLON	MAX SPEED KCAS	SYM LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G		MAX SPEED KCAS	MAX G
SUU-20/A SUU-20/A(M) SSU-20A/A	Clean	550	+4.0	+4.0	80	450	+4.0	550	+4.0	N/A	350	+2.0 -0.0
Clean	SUU-20/A SUU-20/A(M) SUU-20A/A	500						-1.5				
Any Certified Store	SUU-20/A SUU-20/A(M) SUU-20A/A											

Figure 5-5 (Sheet 17A of 22)

INBOARD STATIONS MULTI-WEAPON PYLON (cont)

STORES		CARRY				EJECT FROM PYLONS			JETTISON PYLON WITH STORES	
INBOARD PYLON	OUTBOARD PYLON	MAX SPEED KCAS	SYMMETRIC LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	SALVO MAX G	SINGLE OR SYM PAIRS G	MAX SPEED KCAS	MAX G
MK-61	Clean or with the QRC-160-1, -2, -8 or QRC-335A POD	600 (Mach 1.5)	+5 to -2.5	+3.67	80	600 (Mach 1.5)		Outboard Clean +5 Outboard Not Clean +4	350	+2
MK-61 on one pylon only with opposite pylon clean	Clean or with QRC-160 or QRC335 POD	650 (Mach 1.5)	+5 to -2.5	+3.67	80	650 (Mach 1.5)		Outboard Clean +5 Outboard Not Clean +4	350	+2

Figure 5-5 (Sheet 17B of 22)

INBOARD/OUTBOARD STATIONS

			CARRY				EJECT FROM PYLON			JETTISON PYLON WITH STORE	
INBOARD STATION	OUTBOARD STATION		MAX SPEED KCAS	SYMMETRIC LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	SALVO MAX G	SINGLE OR SYM PAIRS MAX G	MAX SPEED KCAS	MAX G
PYLON ONLY ®			Same as Clean Aircraft				Not Applicable			600	
PYLON ONLY ®	PYLON ONLY ®										
	PYLON ONLY ®										
M-118 (3000 Lb Bomb) When carrying 2 M-118 Bombs fuel management will be necessary	NO STORE PERMITTED	Multi Weapon Pylon	600 (Below M 1.3) 550 with M-1 Fuze Extender	+5.0 -2.5	+3.67	80	SAME AS CARRY SPEED Except MN-1A 500 & Full Rocket Pod 450	+4.0	+4.0	+2.0 G	350 KCAS Except QRC-160 (Pod) 500 KCAS
		Universal B/D Pylon	550 (Below M 1.3)								
M-129 (T-58 Leaflet Bomb) M-117 (750# GP Bomb)* MC-1 (Chemical Bomb)			700®								
	M-129 (T-58 Leaflet Bomb) M-117 (750# GP Bomb)* MC-1 (Chemical Bomb)										
M-129 (T-58 Leaflet Bomb) M-117 (750# GP Bomb)* MC-1 (Chemical Bomb)	M-129 (T-58 Leaflet Bomb) M-117 (750# GP Bomb)* MC-1 (Chemical Bomb)										
LAU-3/A, 18/A, -32, -59 (Rocket Pod) ® or MN-1A (Bomb dispenser) on 30" Rack				+7.33 -3.0	+5.2	125					
M-129 (T-58 Leaflet Bomb) M-117 (750# GP Bomb)* MC-1 (Chemical Bomb)	QRC-160-1, -2 or -8 (Note 6) LAU-3/A, 18/A, -32, -59 (Rocket Pod) ®		600®								
LAU-3/A, 18/A, -32, -59 (Rocket Pod) ® MN-1A (Bomb dispenser) on 30" Rack	QRC-160-1, -2 or -8 (Note 6) LAU-3/A, 18/A, -32, -59 (Rocket Pod) ®		600								
M116A2 or BLU-1 (Fire Bomb) With and without fins			600	+5.0 -2.5	+3.67	80	500 Without Fins				
Clean	M116-A2 or BLU-1 (Fire Bomb) With SK-43C560 fins		500				600 With Fins				

Figure 5-5 (Sheet 18 of 22)

INBOARD/OUTBOARD STATIONS (Cont)

		CARRY				EJECT FROM PYLON			JETTISON PYLON WITH STORE	
INBOARD STATION	OUTBOARD STATION	MAX SPEED KCAS	SYMMETRIC LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	SALVO MAX G	SINGLE OR SYM PAIRS MAX G	MAX SPEED KCAS	MAX G
M116A2 or BLU-1 (Firebomb) With and without fins	M116A2 or BLU-1 (Fire Bomb) ☉ With and without fins	500	+5.0 -2.5	+3.67	80	500	+4.0	+5.0	Outboard Store Ejection with Stores Retained on Inboard MER +2.0 G 350 KCAS Except QRC-160 (Pod) 500 KCAS See Store Limits ☉ ☒ & ☑	+2.0
With Store	M116A2 or BLU-1 (Fire Bomb) ☉ With and without fins									
Clean	M116A2 or BLU-1 (Fire Bomb) ☉ Without fins		+3.3 -2.5	+2.5	80	500	+3.3	+3.3		
Clean	CBU-1/A, -1A/A, 2/A, 2A/A, 2B/A, 2C/A, 3/A, 3A/A (T-5 Dispenser) ☉ CBU-46/A	550	+3.3 -2.5	+2.5	80	550 store empty 500 store full or partial full	N/A	+3.3		
With Store	CBU-1/A, -1A/A, 2/A, 2A/A, 2B/A, 2C/A, 3/A, 3A/A (T-5 Dispenser) ☉ CBU-46/A	500	+5.0 -2.5	+3.67	80		+4.0	+5.0		
MN-1A (Bomb dispenser) On 30" Rack		600	+7.33 -3.0	+5.2	125	500	+4.0	+5.0		
LAU-3/A, 18/A, -32, -59 (Rocket Pod) ☒		600	+7.33 -3.0	+5.2	125	450 Full	+4.0	+5.0		
Clean	LAU-3/A, 18/A, -32, -59 (Rocket Pod) ☒ ☉		+5.0 -3.0	+3.67		600 Empty				
MA-2 (F-105B Adapter) (Rocket Launcher) ☒		SAME AS CLEAN AIRCRAFT				350	+4.0	+5.0		
MA-2 (F-105B Adapter) (Rocket Launcher) ☒	MA-2 (F-105B Adapter) (Rocket Launcher) ☒									
	MA-2 (F-105B Adapter) (Rocket Launcher) ☒									
AGM-12C MWP Pylon Only	Clean or QRC-160-1, -2 or -8 (Note 6)	525 (Below M 1.05)	+4.0 -2.0	+3.0	80	525	+4.0	+4.0		
	2AIM-9B/E (sidewinders) 1AIM-9B/E (With 1 HVAR)	See Store Limit ☐	+7.33 -3.0	+5.0	125	See Store Limit ☐				
AGM-12B (Bullpup)		See Store Limit ☉	+5.0 -2.5	+3.67	80	See Store Limit ☉				
AGM-12B (Bullpup)	AGM-12B (Bullpup) QRC-160-1, -2 or -8 (Note 6)									
	AGM-12B (Bullpup)									

Figure 5-5 (Sheet 19 of 22)

INBOARD/OUTBOARD STATIONS (Cont)

		CARRY					EJECT FROM PYLON			JETTISON PYLON WITH STORE		
INBOARD STATION	OUTBOARD STATION	MAX SPEED KCAS	SYMMETRIC LOAD G		ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	SALVO MAX G	SINGLE OR SYM PAIRS MAX G	MAX SPEED KCAS	G MAX	
	AGM-45A (Strike)	Below 20,000 550 Above 20,000 650	+5.0	-2.5	+3.67	80	550 575	Not Applicable	+5.0	350	+2.0	
Clean	QRC-160-1, -2 or -8 (Note 6) ©	700				125						Not Applicable
CBU-24/B, -29/B, -49/B	Clean	650	+4.0	-2.0	+3.0		Same as carry speed	+3.0	+4.0	350	+1.5	
	CBU-24A/B, -24/B, -24B/B, -29A/B, -29/B, -29B/B, -49A/B, -49/B, -49B/B, -53/B, -54/B.	600										
	Clean	650										
	CBU-24A/B, -24/B, -24B/B, -29A/B, -29/B, -29B/B, -49A/B, -49/B, -49B/B, -53/B, -54/B.											
Clean	CBU-24A/B, -24/B, -24B/B, -29A/A, -29/B, -29B/B, -49A/B, -49/B, -49B/B, -53/B, -54/B.					80						
CBU-24B/B, -29B/B, -49B/B		600	+5.0	-2.5	+3.5		550	+4.0	+5.0			
CBU-24B/B, -29B/B, -49B/B Four CBU-24B/B MER/MWP or MER/UNIV (CBU-29B/B, 49B/B, 53/B or 54/B may be used on the inboard MER.) Mixed loads authorized	CLEAN or any munition authorized with the SUU-30 or QRC-160 and QRC-335 (See Note A for Mixed Store limits)	600	+5.0	-2.5	+3.5	Same as carrying	550	+4.0	+5.0	350 (Full MER)	+2	
		550 MWP 525 MER Both below 1.2M	+4.0	-2.0	+2.5			+2.0	+4.0	275 Partial load	+2	
		500 1.2M										

Figure 5-5 (Sheet 20 of 22)

INBOARD/OUTBOARD STATIONS (Cont)

		CARRY				EJECT FROM PYLON			JETTISON PYLON WITH STORE						
INBOARD STATION	OUTBOARD STATION	MAX SPEED KCAS	SYMMETRIC LOAD G		ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	SALVO MAX G	SINGLE OR SYM PAIRS MAX G	MAX SPEED KCAS	G MAX				
Clean	AN/ALE-2		+4.0	-2.0	+2.0		550		AN/ALE-2 Full + 4.0 AN/ALE-2 Not Full +2.0	400	+2.0				
With Store	AN/ALE-2		+5.0	-2.0	+3.0			AN/ALE-2 Full + 3.0 AN/ALE-2 Not Full +2.0							
Clean	A/B-45Y-2 (Note 1)	550	+4.0	-2.0	+3.0			+3.0		+4.0					
MK-82 (Snakeye) MWP	Clean	600	+5.0	-2.5	+3.67		High drag 500 (Subsonic) Low drag 550 (Below M1.2)	N/A	+5.0	350					
Clean	MK-82 (Snakeye) (Note 1)	575				+4.0									
MK-82 (Snakeye) MWP	MK-82 (Snakeye) (Note 1)														
MK-82 (531 lb bomb) MWP	Clean	600	+5.0	-2.5	+3.67	80	550	N/A	+5.0	Tanks MK-82 350	Tanks MK-82 2.0				
Clean	MK-82 (531 lb bomb) (Note 1)	575						+4.0							
MK-82 (531 lb bomb) MWP	MK-82 (531 lb bomb) (Note 1)														
450 gallon tank	MK-82 with M1AL fuze extender		Tank empty +5.0 Tanks with fuel +4.0	-3.0 -2.0	Tank empty 3.67 Tank with fuel +3.0			525	Same as Carry and dispens- ing						
(See Note A)			+5.0	-3.0											
MK-84 MWP		600 (Below M 1.2)	+5.0	-2.5	+3.67		Same as Carry Speed	N/A	+5.0	350	+2.0				
MK-84 MWP	QRC-160-1, -2 or -8 (Note 6)	550 With M-1 Fuze Extender						+4.0				-2.0	+3.0	600 (Below 500 M 1.2)	+4.0
	MK-83	600 (Below M 1.2)													
MK-84 MWP	MK-83	500 (Below M 1.2)	+4.0	-2.0	+3.67		+3.0	N/A	+4.0						
Fuel Tank May Be Carried With Transmitting QRC-335A Pods	QRC-335A Without Ratg	700	+6.0		+3.67	125				500	+2.0				
	QRC-335A With Ratg	650													

Figure 5-5 (Sheet 21 of 22)

INBOARD/OUTBOARD STATIONS (cont)

STORES		CARRY				EJECT FROM PYLONS			JETTISON PYLON WITH STORES	
INBOARD STATION	OUTBOARD STATION	MAX SPEED KCAS	SYMMETRIC LOAD G	ROLL LOAD G	RATE OF ROLL°/SEC	MAX SPEED KCAS	SALVO MAX G	SINGLES OR SYM PAIRS MAX G	MAX SPEED KCAS	G MAX
Clean or any authorized stores. See Sec. V Note A	BLU-31/B	525	+5.0 -2.5	+3.67	80	525	+5.0	+5.0	350	+2.0

INBOARD/OUTBOARD STATIONS (Cont)

STORES		CARRY				DISPENSING		EJECT		JETTISON PYLON WITH STORE	
INBOARD PYLON	OUTBOARD PYLON	MAX SPEED KCAS	SYM LOAD G	ROLL LOAD G	RATE OF ROLL °/SEC	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G	MAX SPEED KCAS	MAX G
Clean	CBU-7/A (Note 1)	600 (Below M 1.4)	+4.0 -2.0	+3.0	80	600 (400 Min) (Note 2)	+4.0	500 (350 Min)	+4.0	350	+2.0
With Store	CBU-7/A (Note 1)	500	+5.0 -2.0			500 (400 Min)	+5.0		+4.0 (Note 3)		
Clean	CBU-28/A, CBU-30/A or CBU-37/A (Note 1)	600 (Below M 1.4)	+5.0 -3.0 (Note 5)	+3.67		600 (Below M 1.4) (Note 4)	+5.0 (Note 5)	500 Full or Empty	+4.0		

MWP — MULTI WEAPON PYLON — cast magnesium pylon, trailing edge swept AFT from wing to the store.

B/D — Universal B/D Pylon — built up pylon, trailing edge swept FWD from wing to store.

NOTES:

1. Outboard pylon must use strengthened aft yaw pin AF P/N62D7002-1.
2. Do not dispense below 200 feet above ground level. Dispense at 0.1, 0.2, 0.3 or 0.5 second intervals only.

3. Outboard ejection with stores on inboard MER is limited to +2.0G.

4. For maximum CBU-30/A effectiveness, do not dispense at altitudes greater than 500 feet above ground level. This restriction applies to the CBU-30/A only.

5. Outboard symmetric positive G limit is +6.0 if inboard station is NOT clean. (Dependent upon inboard store limit.

6. Stores on which compatibility (HERO) tests have been conducted which can be carried while operating the QRC-160-8 are as follows: Inboard and centerline tanks, AIM-9/B, AGM-12/C and MK-36.

CONFIGURATION			CARRIAGE				DISPENSING	EJECTION			JETTISON
C/L	INBD	OUTBOARD	AIRSPEED	SYM. G'S	ROLL G'S	ROLL RATE	AIRSPEED / G'S	MODE	AIRSPEED	SYM. G'S	KCAS/SYM. G
①	①	SUU-25A/A	500 (Below M0.95)	+3.3 -2.5	+2.5	80°/Sec	500 KCAS (Below M0.95/+3.3G)	②	②	②	350/+1.5

AIRSPEED IN KCAS, ROLL RATE IN DEGREES PER SECOND UNLESS NOTED OTHERWISE.

NOTES:

1. Any other certified store: See T.O. 1F-105D-1, Section V, Note A for mixed store limits.
2. Do not eject dispenser from pylon. Jettison dispenser/pylon combination only.

Drag Numbers:

Inboard Clean — 15

Inboard with Store — 16

FLIGHT OPERATING LIMITS DIAGRAMS

D

See figure 5-5 for maximum operating speed and acceleration and jettison limits.

CONFIGURATION: CLEAN NACA STANDARD DAY
THRUST: MAXIMUM ENGINE: J75-P-19W

HOW TO USE CHART

1. SELECT YOUR INDICATED MACH NUMBER.
2. TRACE VERTICALLY TO YOUR FLIGHT ALTITUDE
3. MOVE HORIZONTALLY TO THE LEFT AND FIND THE MAXIMUM G YOU CAN PULL AT THAT AIRSPEED AND ALTITUDE BEFORE STALLING.

ALTITUDE — 1000 FT

_____ 4
 - - - - - 10
 - . - . - 20
 - - - - - 30
 - - - - - 40

NOTE

The weights stated decrease as internal fuel is expended to reach the higher supersonic speeds. Accelerated stall speeds increase accordingly as aircraft gross weight increases.

mach number

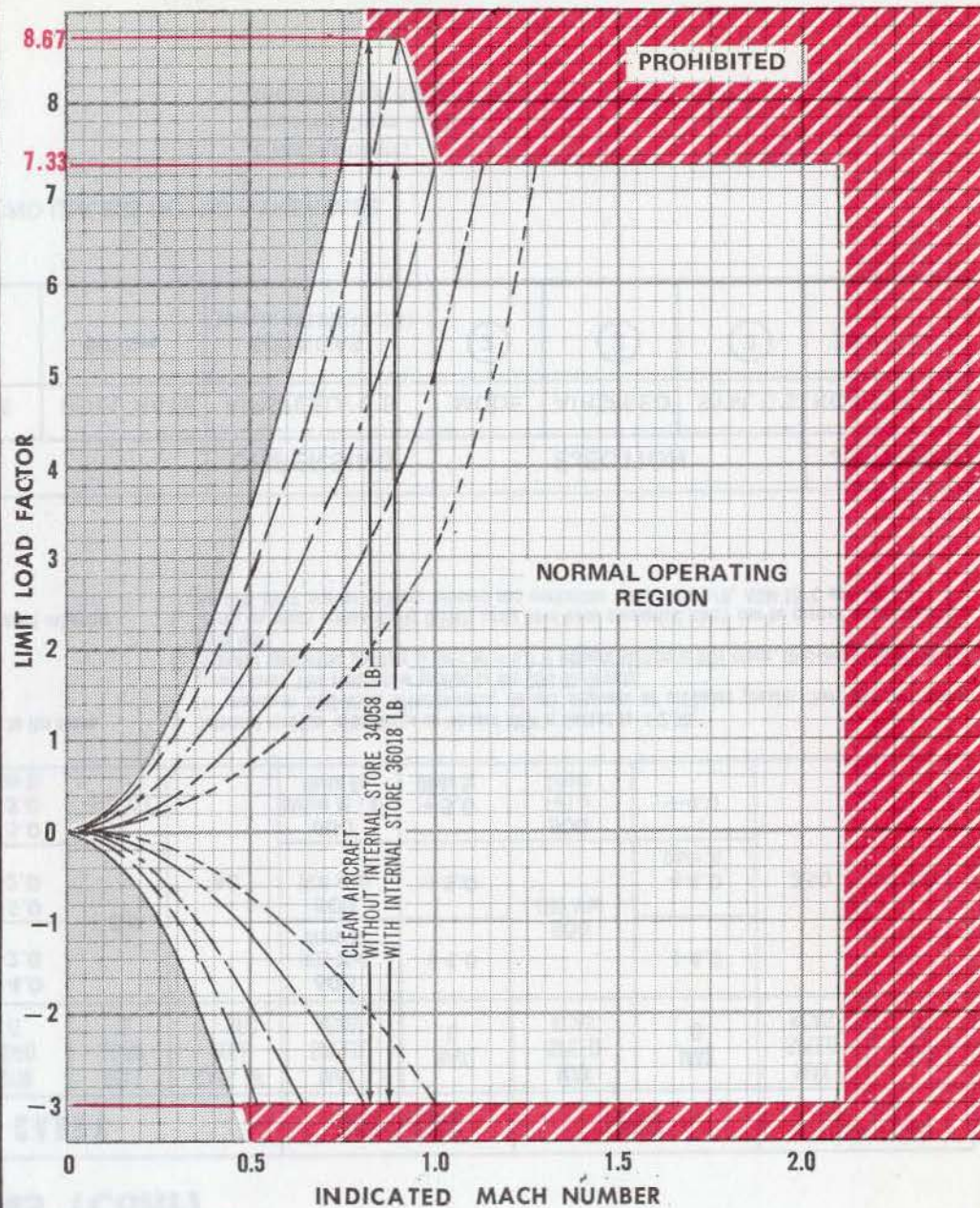


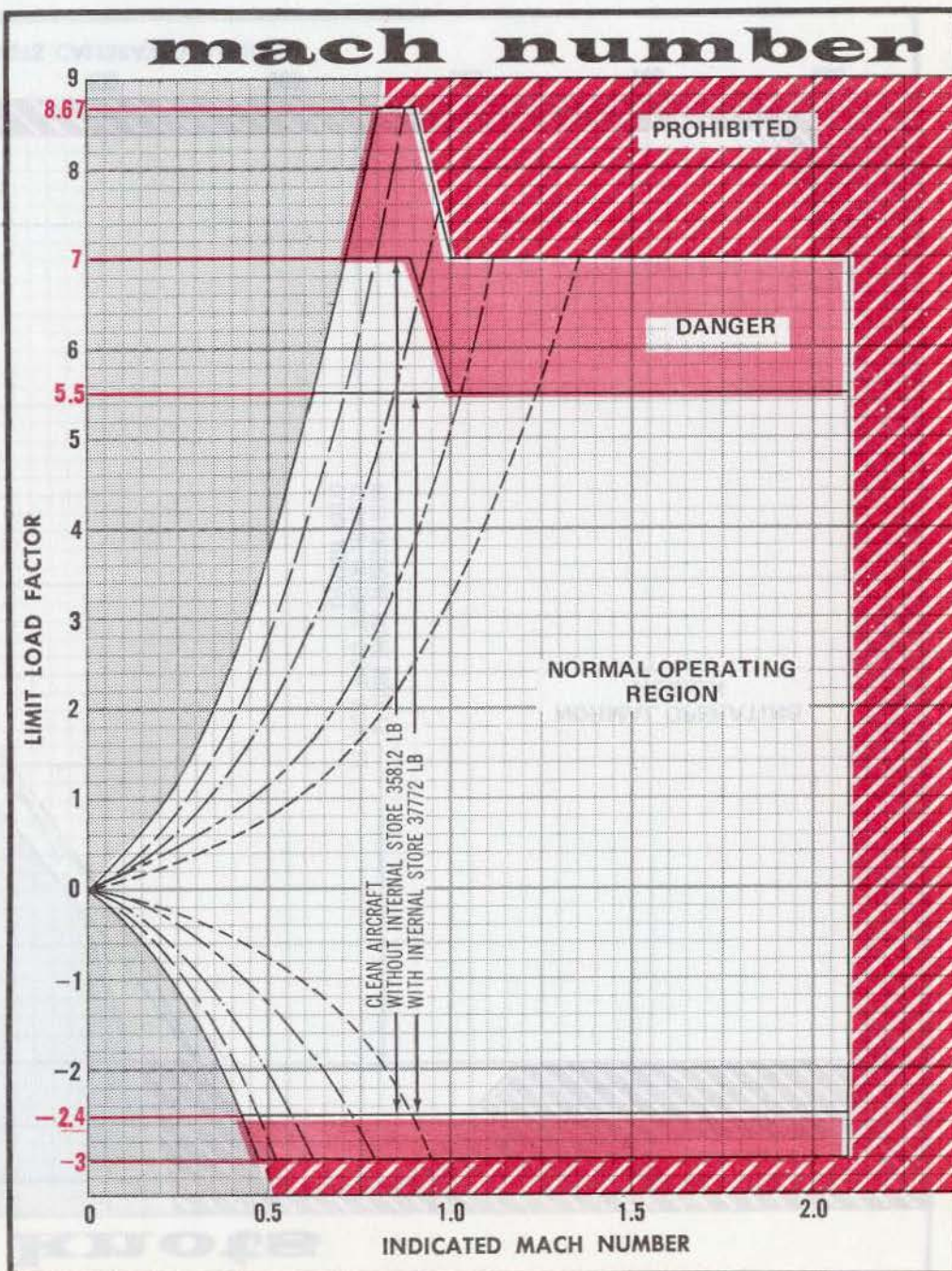
Figure 5-6 (Sheet 1 of 4)

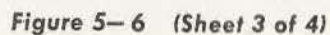
F

NOTE

F A factor of 0.80 is applied to these load factors until completion of static and structural integrity tests.

ALTITUDE — 1000 FT
 ——— 4
 ——— 10
 - - - 20
 - - - 30
 - - - 40





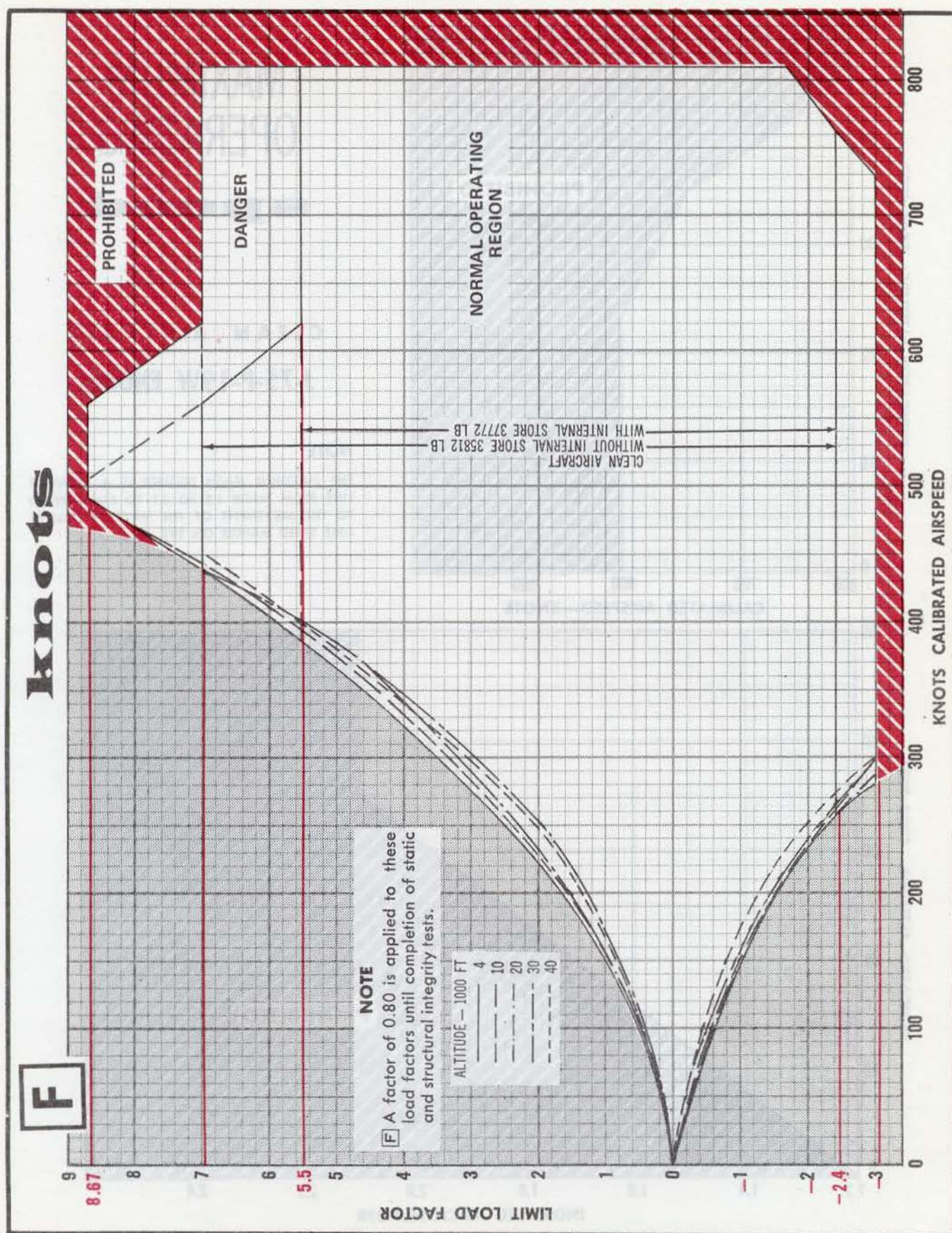
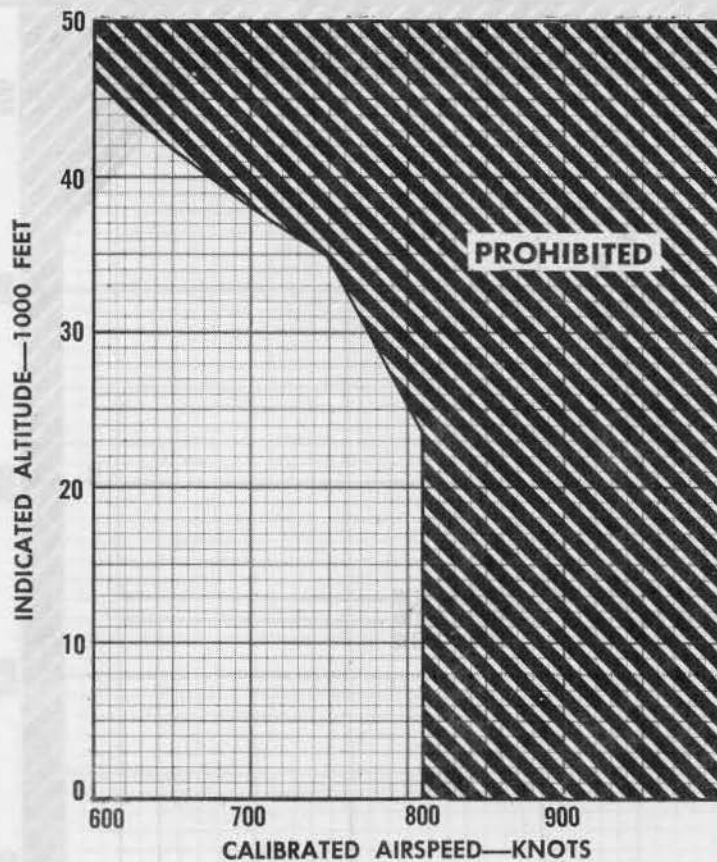


Figure 5—6. (Sheet 4 of 4)



MAXIMUM OPERATING *speed*

CLEAN AIRCRAFT
J-75-P-19W ENGINE

NOTE

THE MAXIMUM MACH NUMBER IS A STRAIGHT LINE FROM MACH 1.2 TO 2.1 TO CORRESPOND TO THE MOVEMENT OF THE MAXIMUM ALLOWABLE SPEED MARKER ON THE AMI.

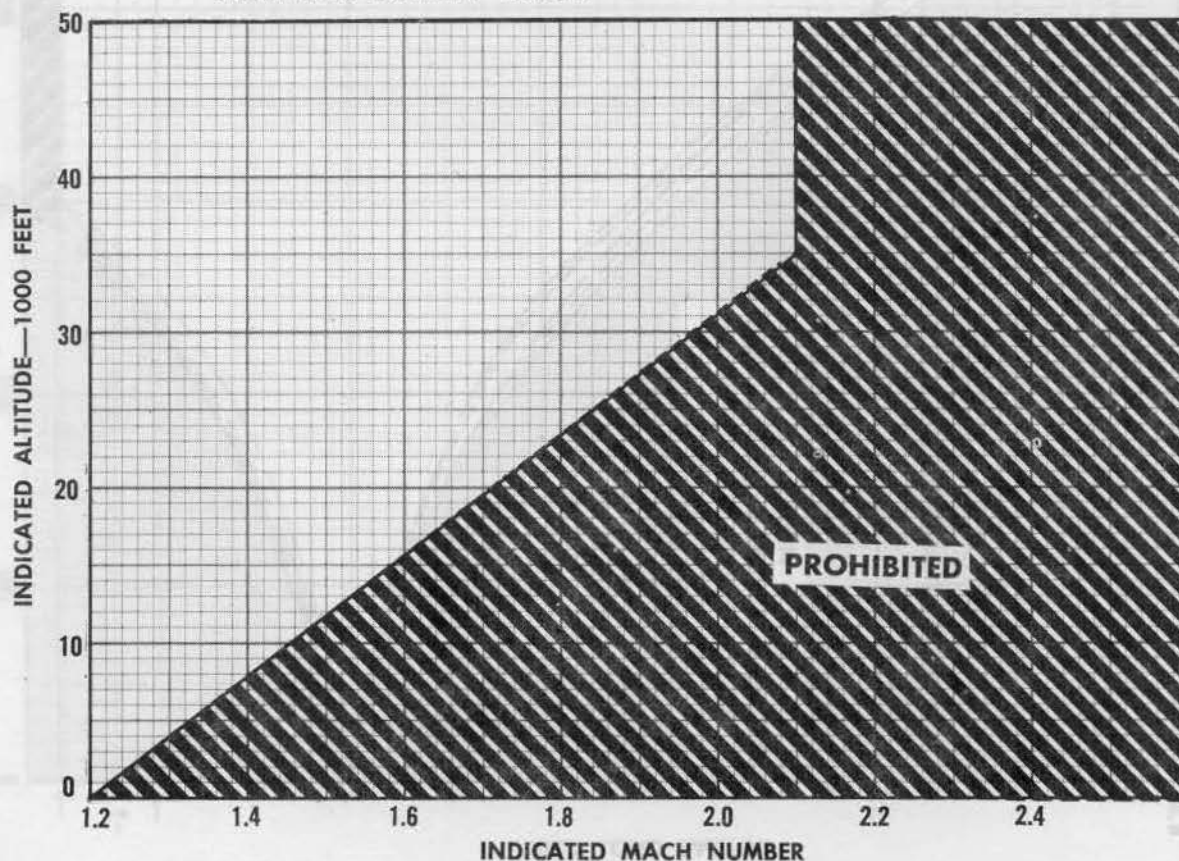


Figure 5-7

Section VI

FLIGHT

CHARACTERISTICS

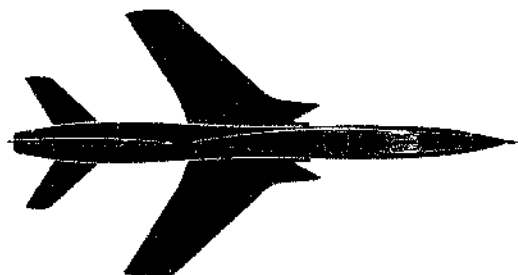


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GENERAL FLIGHT CHARACTERISTICS.

In most areas, the [D] and [E] aircraft exhibit similar flight characteristics. The more forward center of gravity of the [E] results in increased longitudinal stability. This greater stability results in more stabilized deflection per G. At low speed, the [E] has a slight nose heavy condition. The extended nose of the [E] is counteracted by the more forward center of gravity and the larger vertical fin. The dynamic and static lateral-directional stability of the [D] and the [E] are similar. The rudder control power of the [E] is slightly greater than the [D] (more sideslip per degree of rudder deflection) because of the greater tail arm. This aircraft is designed for high speeds at all altitudes. A satisfactory level of stability and control exists throughout the airspeed and altitude range. This is further improved by the use of the stability augmentation system.

ENGINE VIBRATION CHARACTERISTICS.

The high thrust rating of the engine increases certain natural engine vibrations and noise level. Some engines have noticeable vibration at certain RPM ranges. These characteristics may be disconcerting to the pilot if he is not familiar with the vibration characteristics of the particular engine aircraft combination. At approximately 85 percent RPM a slight resonant vibration condition may occur. The vibration is not considered detrimental to engine or aircraft operation provided the engine instruments show normal readings for the thrust setting, speed and altitude. However, a severe vibration occurring at any engine speed should be investigated. Engine vibration as a result of A/B instability may be evident when extended A/B is used with the throttle near the minimum stop.

COMPRESSOR STALLS.

Four generalized categories of compressor stalls may be experienced:

a. Subsonic Chugging During Engine Accelerations or Decelerations.

During engine acceleration, or deceleration, an incipient partial stall condition or chug may be evident. When this occurs, it is an indication of an internal engine malfunction, and the aircraft should be landed as soon as practical, and written up in the Form 781 to initiate a maintenance investigation. If a hangup or rising EGT condition develops, the throttle should be retarded to IDLE. Subsequent slow movement of the throttle may be accomplished as interim correction in flight. An investigation should be made on the ground to determine the cause.

b. High Mach Number Engine Stall.

At high Mach numbers in the vicinity of 1.8, intermittent occurrence of roughness and, in rare instances, loud bangs emanating from the ducts may be experienced. In addition, stalls can occur immediately following an afterburner re-light at supersonic speeds as well as during normal accelerations. If high Mach engine stalls are encountered, the aircraft should be decelerated rapidly by turning the afterburner off, opening the speed brakes, pulling up in a climb attitude and reducing the throttle to IDLE when speed is below Mach 1.3. Incorrect procedure (retarding the throttle at speeds above Mach 1.3) will result in the disturbance continuing until speed is reduced considerably. This phenomenon is indicative of mild engine inlet flow instability. However, test data have shown that the disturbances are well within the structural capabilities of the aircraft engine combination.

WARNING

If during deceleration, a climbing attitude is selected, do not climb to or above altitudes where a pressure suit is required.

c. Stall During A/B Lights at Altitude.

Occasionally stall will be experienced during A/B lights at altitude where the coordination of the opening of the afterburner nozzle, the fuel flow and the combustion all influence back pressure imposed on the engine. On any A/B light above 25,000 feet it is acceptable

for the engine to "Chug" or "Stall" once providing the EGT does not exceed the limits shown in section V.

d. Chugging or Partial Stall During Accelerated Turns.

Engine stall and/or power loss may occur anytime the aircraft flight attitude is such that blanketing or severe airflow distortion occurs at engine air inlet. This condition will normally be encountered during maneuvers involving substantial yaw or during the advanced stages of a normal or high speed stall. The engine should recover from these stalls and/or power losses normally when maneuver is broken off.

WARNING

When an aircraft is flown into one of these uncoordinated maneuvers and engine stalls and/or power loss occurs, maneuver should be broken off immediately. If maneuver is not broken off, engine will drop to minimum fuel flow, which is far below normal idle, or will actually flame-out.

e. Gun Firing in Flight.

During gun firing in flight, the gun gases may flow into the inlet and be ingested by the engine. This results in a momentary lack of oxygen and a sharp temperature rise in the inlet. Dependent on the flight conditions and throttle setting, the ingested gun gas may result in engine surge, decrease in pressure ratio, thrust loss, etc. and may last 0.4 to 0.6 seconds. If engine surge is encountered during gun firing an entry will be made in the Form 781 and the intake ducting and VAI plugs will be inspected for cracks and pulled rivets.

CHUGGING OR PARTIAL STALL WHEN RAM AIR TURBINE IS EXTENDED.

If both primary hydraulic systems fail, or any emergency that necessitates an engine shutdown, the ram air turbine is extended. A windmilling engine at recommended glide speeds will provide hydraulic pressure; however, it is recommended that the RAT be extended to provide positive hydraulic pressure. The extension of the ram air turbine may be accomplished for testing purposes with the engine running, and experience shows that chugging or partial

compressor stall can occur under certain airspeed, altitude, engine and atmospheric conditions. If chugging develops or persists, the ram air turbine should be retracted as quickly as possible after completion of the test.

FLIGHT CONTROL EFFECTIVENESS.

Either primary one or primary two hydraulic flight control system is capable of providing sufficient power for control at any speed as well as limited maneuvering. The RAT can be used throughout most of the flight envelope (see section V for limits).

ROLL CONTROL.

The lateral control system provides satisfactory roll control throughout the flight range. A slight lateral trim requirement due to minute wing asymmetry may develop, and probably will increase above Mach 0.9. The direction and amount of lateral stick required is variable from aircraft to aircraft. Above 700 KCAS, a slight change of trim requirement may occur at aileron lockout. Lateral control effectiveness at pattern speeds is greatly increased when the trailing edge flaps are deflected. Large roll corrections (spoiler deflections) at slow airspeeds, as when landing in turbulence or crosswinds, will detract considerably from lift.

PITCH CONTROL.

The aircraft is free of any pitch up tendencies and has effective pitch control. Pitch control is affected by:

- the wide range of permissible configurations.
- speed brake deployment, which reduces effectiveness.

A system known as the CVMAS (Continuously Variable Mechanical Advantage Shifter) is incorporated in the stabilizer control system to produce more uniform pitch maneuvering control characteristics throughout the flight range, and to reduce control stick sensitivity at high speeds at low altitude. The CVMAS changes mechanical advantages as a smooth continuous function of Mach number and altitude. The flight control system minimizes the possibility of pilot induced oscillations. The pilot should be aware of the primary causes of pitch oscillation which are as follows:

- Dive recoveries involving abnormally large, rapid stick inputs.

- Abnormal stick reversals in pitch such as might be encountered in severe air combat maneuvering.
- Rapid stick reversals in pitch such as might be encountered in severe air combat maneuvering.

Pilot induced oscillations are most likely to be a problem if pitch over control results in negative G.

CAUTION

Pilot attempts to stop pitch oscillations with control movement will probably be improperly phased and may make them more severe. If pilot control inputs continue, the aircraft may be stressed beyond allowable limits.

- Abnormally large, rapid stick movements during dive recoveries will result in planned G being exceeded.

Aircraft acceleration during steep dives is extremely rapid and it is easy to exceed planned dive speeds. Abnormally large rapid stick movements during dive recoveries can result in planned G being exceeded. Rate of G buildup at first will seem slow but as the aircraft continues to rotate, G will build up at a rapid rate. It is almost impossible for a pilot to estimate peak G's which may be encountered during this type of recovery. The aircraft can be safely flown through normal delivery maneuvers with stability augmentation disengaged provided the pilot recognizes the resulting increased flight control sensitivity and adjusts control techniques accordingly.

To recover from pitch oscillations induced by pilot control techniques: Neutralize the stick or apply slight aft pressure; extend speed brakes. If conditions permit, let go of the stick until oscillations stop.

To reduce the possibility of entering into a pilot induced pitch oscillation:

1. Adhere to the dive recovery charts when planning dive attacks.
2. Initiate dive recoveries by smooth steady application of back stick pressure. Any G load not exceeding the limits in the acceleration and jettison limits table in section V may be used.

ⓔ The F model is more sensitive in pitch control in level flight.

YAW CONTROL.

The rudder is effective at all speeds above 60 knots.

WING FLAPS.

The deflection of leading edge flaps reduces drag, and delays the onset of buffet during subsonic cruise and maneuvering flight as well as for takeoff and landing. A leading edge flap position of 40 percent is recommended as a good maneuvering and cruise position for subsonic flight, 100 percent is recommended for takeoff and landing, while zero percent leading edge should be used supersonically (see section V for limits). There is a very slight nose down pitch change associated with deflection of full leading edge flaps. Trailing edge flaps provide extra lift which decreases takeoff landing speeds and distances. Retraction of these flaps after takeoff results in mild nose up pitch change. Upon extension, a slight nose down effect and increased lateral control will be noted. Some buffet will be noted when the flaps are in the fully extended position with the landing gear down. With the landing gear retracted the buffet level is reduced. As the speed is increased above approximately 260 KCAS the buffet becomes moderate.

SPEED BRAKES.

Speed brakes can be extended at any speed and are very effective. They provide excellent deceleration from any speed with barely detectable trim changes. There is no buffet associated with extension of speed brakes. More aft stick is required to pull a desired G with the speed brakes extended.

LEVEL FLIGHT CHARACTERISTICS.**LOW SPEED.**

The low speed characteristics and handling qualities are good. Aileron and spoiler control is good in the clean and landing configuration. Extension of the trailing edge flaps increases the effectiveness of lateral control. Some lateral wallowing will be apparent as warning of approaching stall at the lowest speeds, but is readily controllable.

CAUTION

Avoid flying directly behind any aircraft while in close formation as the wake turbulence may cause loss of aircraft control.

Ⓔ On F aircraft a nose heavy effect will be evident below 300 KCAS in comparison to the D aircraft.

CAUTION

During slow speed flight or landing approach:

- The aircraft response is slower so that more flight control deflection is required for the same aircraft response. If the engine RPM is low, or at idle, use of flight controls at high rates may cause a momentary control "stiffening." This situation is most likely to occur during a cross-wind landing, when rapid simultaneous lateral and longitudinal control are required. Stick stiffening can be avoided by flying a smooth, flat final approach with slightly increased engine RPM.
- At speeds below 175 knots, with reduced power, deceleration is rapid and a very high sink rate will result.

CRUISE AND HIGH SPEED.

The aircraft trims well throughout the entire speed range. A small transonic trim change occurs between Mach numbers 0.90 and 1.02. This trim change varies with altitude and is barely noticeable at low altitudes. In 1G flight, the aircraft does not encounter buffet.

MANEUVERING FLIGHT CHARACTERISTICS.

The aircraft has high rate of climb, good G potential, and satisfactory roll capabilities throughout the flight range.

WARNING

With the high speed capability of this aircraft, the wing is capable of developing load factors that can destroy the aircraft. Maneuvering limits must be carefully observed at all altitudes.

STALLS (SUBSONIC).

As in most modern high speed aircraft, there is no well defined classic stall, but a sequence of buffet, excessive thrust requirement, high sink rate, and deterioration of lateral control as airspeed decreases. The buffet boundary is quite wide from initial onset of buffet to deterioration of lateral control and the intensity build up of buffet is slight. See figure 6-1 for stall speed and minimum safe flying speeds for various gross weights. Observation of these speeds will not handicap the operation of the aircraft as they are below recommended pattern and touch-down speeds. Maneuvering deeply into buffet reduces directional stability and can result in snap

MINIMUM SAFE FLYING SPEEDS

Speed at which significant deterioration of lateral control and lateral directional wallowing are noted, probably accompanied by heavier buffet.

maximum thrust

CONFIGURATION LEGEND

----- CRUISE
 _____ TAKEOFF & LANDING (GEAR DOWN, TE FLAPS 100%, LE FLAPS 100%)

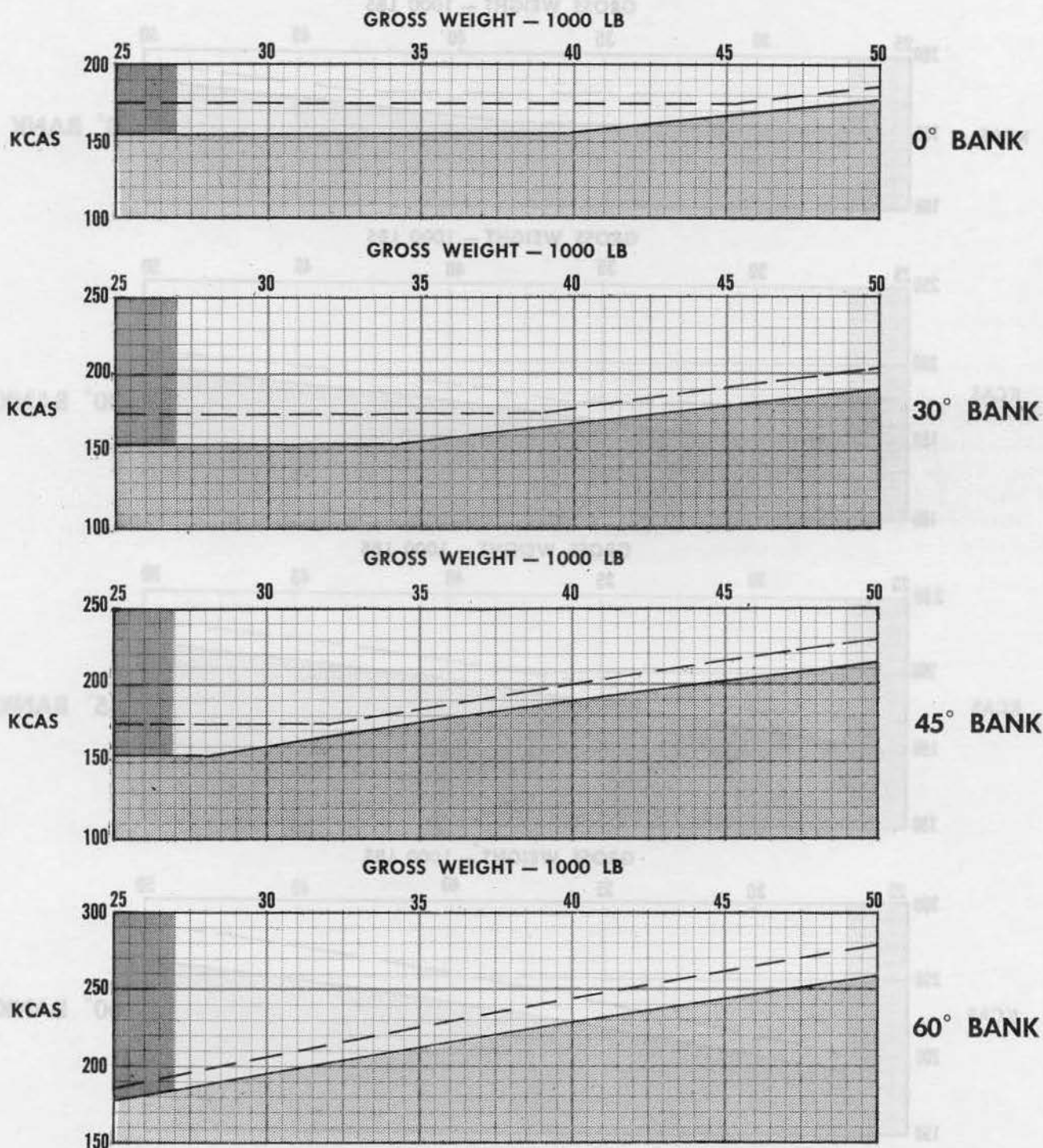


Figure 6-1. (Sheet 1 of 3)

military thrust

CONFIGURATION LEGEND

----- CRUISE

———— TAKEOFF & LANDING (GEAR DOWN, TE FLAPS 100%, LE FLAPS 100%)

GROSS WEIGHT — 1000 LBS

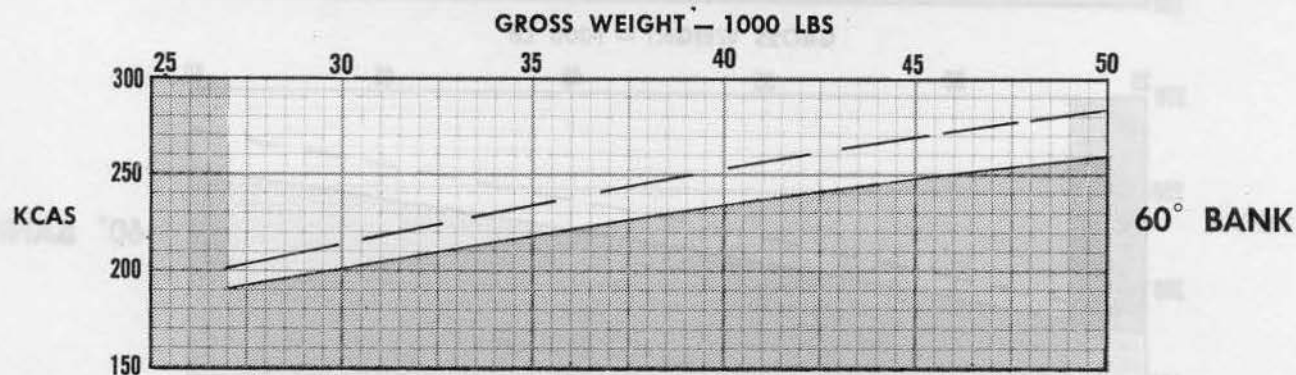
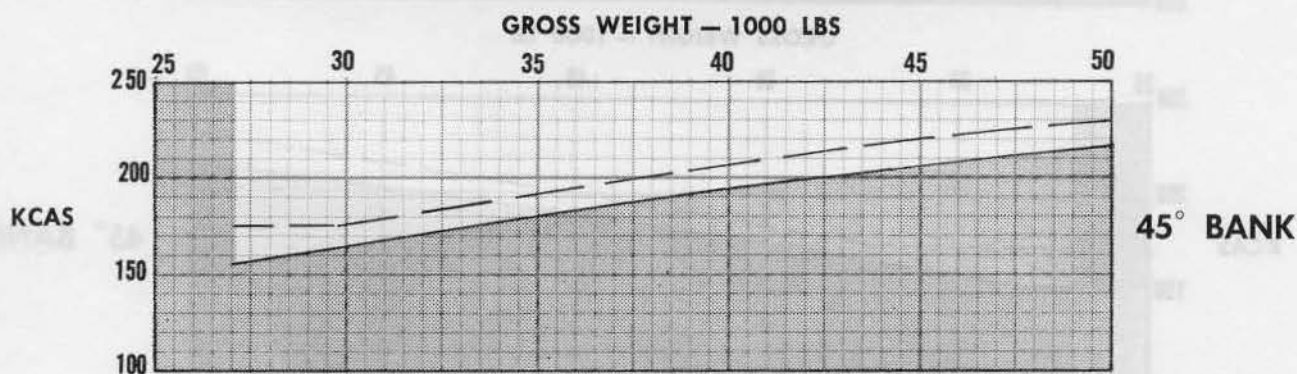
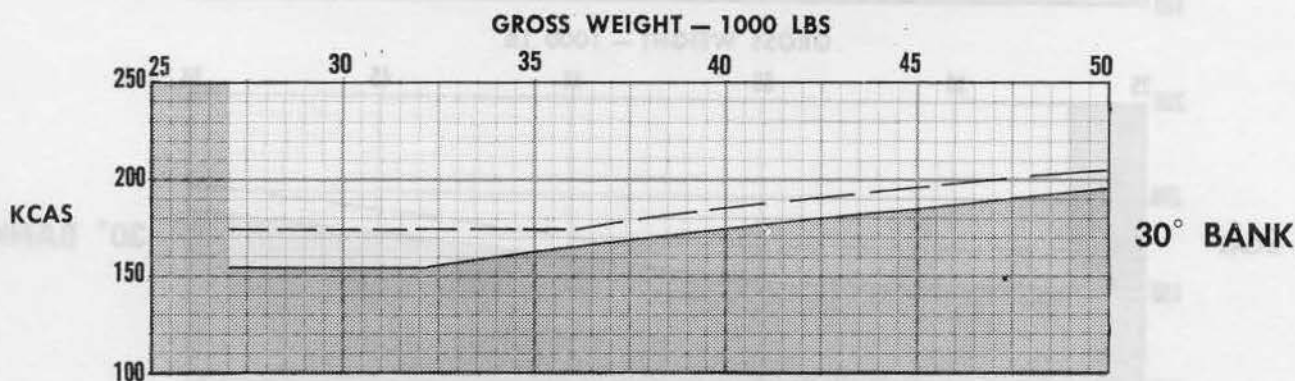
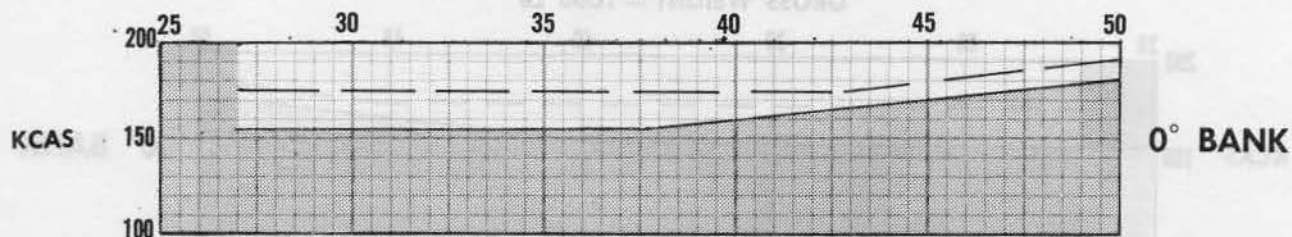


Figure 6-1. (Sheet 2 of 3)

power-off

CONFIGURATION LEGEND

- CRUISE
 — TAKEOFF & LANDING (GEAR DOWN, TE FLAPS 100%, LE FLAPS 100%)

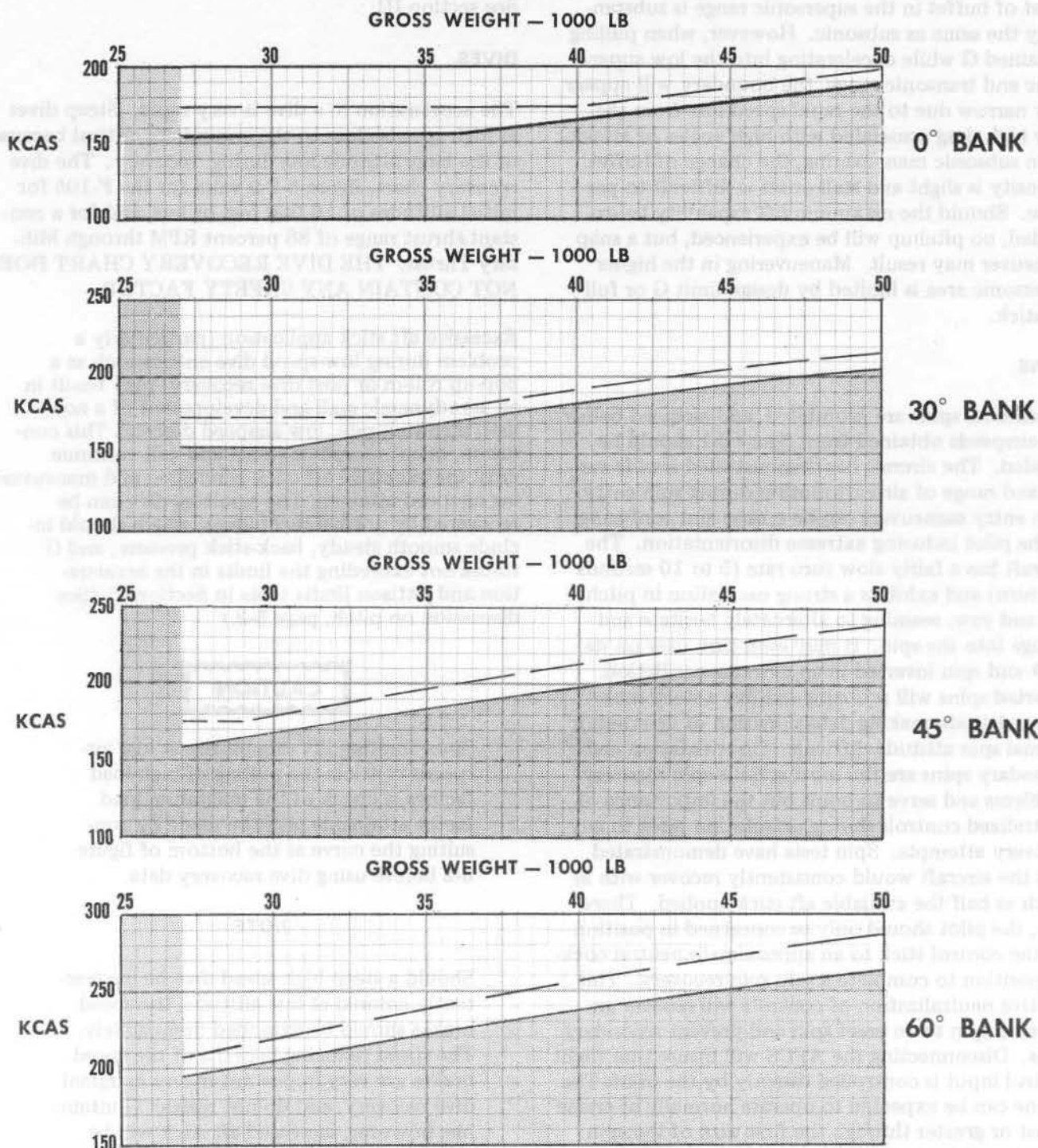


Figure 6-1. (Sheet 3 of 3)

maneuvers at high speed, or spins at low speeds. It is recommended that further maneuvering into the buffet boundary be terminated when a major deterioration of lateral control is noted.

STALLS (SUPERSONIC).

Supersonic buffet characteristics are similar to the subsonic. The maneuvering G available beyond the onset of buffet in the supersonic range is substantially the same as subsonic. However, when pulling sustained G while decelerating into the low supersonic and transonic range, the boundary will appear very narrow due to the rapid speed loss from the very high drag associated with high angles of attack. As in subsonic maneuvering, the change of buffet intensity is slight and stall onset is difficult to perceive. Should the maximum lift capability be exceeded, no pitchup will be experienced, but a snap maneuver may result. Maneuvering in the higher supersonic area is limited by design limit G or full aft stick.

SPINS.

Intentional spins are prohibited, and airspeed below the airspeeds obtained from figure 6-1 should be avoided. The aircraft has demonstrated a wide variety and range of aircraft motion during spin entry. Spin entry maneuvers can be erratic and confusing to the pilot inducing extreme disorientation. The aircraft has a fairly slow turn rate (5 to 10 seconds per turn) and exhibits a strong oscillation in pitch, roll and yaw, seeming to alternately hesitate and plunge into the spin. It may even turn over on its back and spin inverted in an extreme oscillation. Inverted spins will probably exhibit a steep nose-down attitude making determination of inverted or normal spin attitude difficult. Disorientation and secondary spins are the most serious spin recovery problems and serve to point out the importance of neutralized controls during orientation prior to any recovery attempts. Spin tests have demonstrated that the aircraft would consistently recover with as much as half the available aft stick applied. Therefore, the pilot should only be concerned in positioning the control stick to an approximate neutral cockpit position to complete a safe spin recovery. This positive neutralization of controls will recover an inverted spin to an erect spin and prevent secondary spins. Disconnecting the AFCS will insure that flight control input is controlled directly by the pilot. The engine can be expected to operate normally at cruise thrust or greater through the first turn of the spin. However, it is considered advisable to retard the throttle to IDLE. Leading edge flap configuration,

cruise-maneuver (40 percent) or high speed (0 percent), has no effect on spin or recovery characteristics.

Altitude Loss — Fully developed spins can be expected to lose 2200 feet per turn. Recovery to level flight can be expected to require 10,000 feet.

SPIN RECOVERY.

See section III.

DIVES.

The acceleration in a dive is very rapid. Steep dives at high speeds close to the ground are critical because of the large altitude loss during recovery. The dive recovery chart, figure 6-2 is valid for the F-105 for initial altitudes of 10,000 feet or less, and for a constant thrust range of 88 percent RPM through Military Thrust. **THE DIVE RECOVERY CHART DOES NOT CONTAIN ANY SAFETY FACTOR.**

Excessive aft stick application (particularly a problem during low-speed dive entries such as a pop-up roll-in or post dive recovery) may result in an aerodynamic stall and development of a nose-low, high-sink-rate, low airspeed descent. This condition, once entered, is stable and will continue until the excessive aft stick is released and maneuvering airspeed attained. The resulting dive can be recovered by normal techniques, which should include smooth steady, back-stick pressure, and G forces not exceeding the limits in the acceleration and jettison limits table in Section V. (See discussion on pitch, page 6-3.)

CAUTION

Since limiting lift capabilities at low airspeeds restricts the pulling of high load factors, a check of the maximum load factor attainable must be made by consulting the curve at the bottom of figure 6-2 before using dive recovery data.

NOTE

Should a steep high speed dive be inadvertently entered at low altitude, the speed brakes should be extended immediately. The speed reducing benefits of the speed brakes are very important in any marginal dive recovery, and do not restrict G attainable, however, increased aft stick will be required to pull G due to a reduction in stabilizer effectiveness. Full leading edge

flaps delay the onset of buffet and make the recovery more comfortable.

DIVE RECOVERY CHART.

Sample Problem:

If a 5 "g" pullout from a 55 degree dive at 470 knots

Calibrated Airspeed is initiated at 10,000 ft (Standard Temperature Day) with an F105 weighing 40,000 lb, the altitude lost during dive recovery will be 3650 ft.

1. Check the maximum load factor attainable by entering the chart at 470 KCAS, (A), moving

DIVE RECOVERY CHART FOR ALTITUDES OF 10000 FEET OR LESS NO SAFETY FACTOR

THE RATE OF G ONSET IS 2 G'S PER SECOND

GROSS WEIGHT
(a) 30000 LB
(b) 35000 LB
(c) 40000 LB
(d) 45000 LB

CALIBRATED AIRSPEED - KNOTS

MAXIMUM LOAD FACTOR

PRESSURE ALTITUDE
2000 FT
4000 FT
6000 FT
8000 FT
10000 FT

LOAD FACTOR
4 G
5 G
6 G

ALTITUDE LOST - 1000 FEET

AMBIENT TEMPERATURE
60°C
40°C
20°C
0°C
-20°C
-40°C
-60°C

DIVE ANGLE
30°
35°
40°
45°
50°
55°
60°

Figure 6-2

horizontally to the left to the line representing 40,000 lbs. gross weight, (B) and vertically to read maximum load factor = 6.5 "g" at (C). The required 5 "g" pullout can therefore be achieved.

2. From 470 KCAS (A), move horizontally to the right to Pressure Altitude = 10,000 ft (D), and drop to Standard Ambient Temperature = -5°C, (E).
3. Move to the right to dive angle of 55 degrees, (F), and up to load factor of 5g, (G). Move to the right and read altitude lost during pullout = 3650 ft at (H).

WAKE TURBULENCE.

In high-speed, high-G maneuvers, expect high instantaneous G's and rapid changes in angle of attack and aircraft attitude when wake turbulence is encountered. At lower speeds, such as in the traffic pattern, large roll and yaw corrections may be required to maintain attitude. Adequate control is available but rapid control corrections combined with downwash effects of wake turbulence may create a high sink rate and require power application to continue the approach or go-around.

ROLLS.

As the aircraft has a major portion of its mass concentrated along the fuselage, inertia forces have an important effect on its rolling characteristics. These inertia effects are such that adverse yaw is strong at low speed and complementary yaw occurs at high speeds.

Low Speed.

The application of aft stick in rolling at speeds below approximately 450 KCAS will markedly increase adverse yaw, increase the side G, and reduce the roll rate. This type of stick application is often inadvertent and at lower speeds (below 350 KCAS), extreme results may approach conditions for entry to a snap roll or spin due to large yaw angles near stall conditions.

Note

Reduction of lateral stick deflection is effective for reducing side-slip angles in extreme roll maneuvers.

High Speed.

Rolls at speeds above approximately 600 KCAS will exhibit complementary yaw. Application of forward stick to less than 1G tends to increase complementary yaw and to increase the roll rate markedly. Additional forward stick application

in such a maneuver increases this effect, and in severe misuse could result in control difficulties due to a continuing increase in roll rate.

EFFECTS OF CONFIGURATION.

LANDING GEAR.

Retraction of the landing gear will result in a nose down pitch change. Extension of the landing gear results in the opposite effect. The use of Military thrust for takeoff will cause a more pronounced effect. Inboard pylons and stores substantially alleviate this effect. The nose down pitch change associated with gear retraction will be noted to a greater degree during a go-around for two reasons. First — most go-arounds will be accomplished at Military thrust. Second — the aircraft attitude will be closer to level when the landing gear is retracted thus giving the impression of a greater change. During go-around, care should be taken that the speed brakes are retracted prior to or simultaneously with, application of thrust since, if the speed brake switch is in the OUT position when the landing gear is retracted, the top and bottom speed brakes will extend resulting in a net increase in drag instead of the desired reduction.

EXTERNAL STORES.

The installation of the many stores possible on the various external stations affects the aircraft flying qualities and handling characteristics through combinations of the following factors:

- Store location effect on the aircraft Center of Gravity.
- Store weight effect on aircraft gross weight and inertia.
- Store aerodynamic effects.

Effects of specific store installations follow:

- Stores on the inboard underwing station reduce longitudinal stability. The magnitude of this effect is a function of the size of the store and the distance that it projects forward of the wing (450 gallon tanks cause the greatest effect and individual M-117 bombs cause the least).
- Stores on the outboard wing pylon station cause negligible aerodynamic effect on longitudinal stability. The greatest CG travel proportional to store weight results from stores at this station.
- Installation of stores on the centerline station has very little effect on longitudinal stability

but moves the CG forward. The directional stability is slightly reduced by installation of large centerline stores especially when maneuvering deeply into the buffet area. However, this reduction is slight and occurs in the clean configuration as well.

Symmetrical Loading on Wing and Centerline Pylon Stations:

- Minor vibrations (directional and vertical oscillations) may be felt during the takeoff roll due to the flexibility of the pylons and mass of the stores.
- Aft CG configurations will cause the takeoff rotation to be more sensitive and care should be taken during rotation to avoid excessive angle of attack during initial climbout.

Flight characteristics of certain stores warrant specific description:

- Blunt nosed stores installed on the wing pylons will buffet noticeably at transonic speeds.
- M-117 bombs on the pylon multiple ejection racks (MER) may induce an airframe buffet in the 0.75M to 1.0M range.
- M-117 or BLU-1/B bombs on the centerline MER will cause buffet and directional oscillation of the aircraft.
- Formation flying with external stores will differ from normal operation in response to lateral control inputs. Roll response should be taken into consideration when flying close maneuvering formation. With stores, the initial roll response is reduced from that of the clean aircraft.

CAUTION

Failure to observe the roll rate limits may result in structural failure of the wing-pylon attachments. See figure 5-5. Large initial deflection should be promptly reduced when rolling through more than 30-40 degrees. Initial deflection of more than one-half-stick and intentional 360 degree rolls with heavy stores should not be performed.

Landing with heavy external stores:

- Recommended approach speeds and glide angle must be adhered to. Landings must be at very low sink rates.

Note

The angle of attack indicator is very useful in determination of proper speeds for approach and landing.

ASYMMETRIC LOADINGS.

Note

These descriptions are applicable to the most severe conditions, those of full tanks, heavy stores (2000 lbs or more) and MER adapters with stores installed. Similar effects, but of lesser magnitude, exist with smaller and lighter stores.

The flight characteristics are somewhat different with asymmetric store loadings. These effects are primarily associated with weight unbalance and the resultant rolling and yawing movements. There are also relatively minor secondary aerodynamic roll and yaw effects. The first different characteristic from the symmetrically loaded aircraft will be noted at brake release and afterburner light on the takeoff roll. The aircraft will pull in the direction of asymmetric load. This effect can easily be handled by use of nose wheel steering or tapping the brake until the rudder becomes effective (approximately 60 KCAS).

Prior to starting takeoff the pilot should trim in some lateral stick away from the heavy wing (about 1 inch for 2000 pounds of asymmetrical load), otherwise the heavy wing will tend to drop at lift off. Following lift off, retrimming will be required to compensate for the gear and flap retraction and the effect of the speed changes on the asymmetric trim requirements. This is caused by the acceleration of the aircraft which results in a yaw into the heavy wing. Lateral trim requirements will reduce, depending on the amount initially set in as the aileron and spoiler effectiveness increases. Pitch, roll and yaw trim will again need attention when the afterburner is shut down.

The remainder of an asymmetrically loaded mission will require attention to retrimming as altitude, airspeed, fuel weight, load factor, etc., change. For

example, the aircraft will yaw into or away from the heavy wing respectively due to inertia of the store, with abrupt increase or decrease in speed. Positive or negative load factors will cause the heavy wing to drop or lift. In turns toward the heavy wing the aircraft will tend to roll further into the turn. As G's are applied in turns away from the heavy wing, the aircraft will tend to level itself. The tighter the turn, the greater the effect. When pulling the aircraft into stall buffet at low airspeeds or high G's, a noticeable increase in the amount of lateral control required will be encountered as buffet is entered. This is caused by reduced lateral control effectiveness as the wing stall starts to develop. This reduction in control effectiveness will progress until lateral control may become marginal with large asymmetric loadings as moderate to heavy buffet is reached. This is also true in turns or straight pull-ups. The onset of buffet should be used as a maneuvering limit when asymmetrically loaded to insure adequate lateral control. Increased lateral control requirement with G's at high Q is slight due to high aileron and spoiler effectiveness at the higher speeds.

The most unusual trim characteristics experienced with an asymmetrical loading will be those encountered with the combination of a 450-gallon fuel tank on one inboard station and a special weapon on the other inboard station, with or without a centerline tank. This combination is easily handled since the magnitude of the trim changes are small but their variations with airspeed are somewhat unique. Below 400 KCAS as fuel is used from the external wing tank, the opposite wing (with the store) will, as expected, be the heavier, requiring lateral trim. Above 400 KCAS (even with an empty tank) the wing with the tank will appear to be the heavier due to aerodynamic effects resulting in a reversal of lateral and directional trim requirements. This is due to the fact that drag of the tank becomes greater than that of the store above airspeeds of 400 KCAS causing the changeover of trim effects described above. Minor directional and lateral trim changes will also be noted in the transonic region. All of these effects can easily be handled within the capability of the trim systems. When releasing stores asymmetrically under G's (toss maneuvers) the pilot should expect a sudden out-of-trim condition in roll and yaw due to the release of the store. This is a natural result of the removal of the configuration causing the trim requirements and consequently merely requires that the controls be returned to neutral.

The automatic bomb delivery pullup (Autoss) system is designed to fly the symmetrically loaded

aircraft through a carefully regulated Immelmann. When stores are carried asymmetrically, a manual pullup is required because the autopilot system is not designed to properly maintain wings level with large asymmetry.

During symmetrically loaded Autoss deliveries where only one store is released, the aircraft becomes asymmetrical at store release, with the momentary roll off described above. The Autoss mode of the autopilot is not capable of handling this trim change, therefore it is recommended that the autopilot be disconnected using the emergency disconnect lever immediately after store release, while the pilot completes the maneuver manually.

Landing the asymmetrically loaded aircraft is not difficult but requires consideration of cross wind, gust factors, visibility, runway condition, etc. As previously stated, the major cause of lateral control requirements with asymmetric store configurations is that of weight unbalance and not aerodynamic unbalance, thus the effects are most noticed at the lower airspeeds prior to flap extension where lateral control effectiveness is at a minimum.

WARNING

With one full 450 gallon wing pylon tank, or equivalent weight store, and trailing edge flaps retracted full lateral control is required to hold wings level at 200 KCAS. At lower speeds lateral control is insufficient to hold wings level. If store cannot be jettisoned, and trailing edge flaps cannot be extended, add 20 percent to pattern and landing speeds.

Landing patterns should be made turning away from the heavy wing as far as practicable. Turns into the heavy wing must be made in a shallow bank keeping the airspeed at least 10 percent above recommended normal landing pattern speeds. If turns into the store are used and they are tightened to make a runway, the bank will steepen due to the asymmetry forcing the pilot to apply more back stick which steepens bank even more. Altitude and speed are lost and a steep spiral will result. The landing pattern in section II is satisfactory when the speeds are increased by approximately 10 percent.

The last item of interest and caution is landing the asymmetrically loaded aircraft under crosswind conditions. It is preferable to fly the final approach

in a crab rather than one wing low, and kick out most of the crab during flare prior to touchdown. The crosswind landing chart in the Appendix is applicable. As the drag chute is deployed, and the aircraft decelerates, the aircraft tends to turn away from the store. This is the opposite of the takeoff condition; however, it is not as pronounced and is easily controlled with rudder down to braking or nose wheel steering speeds. This turning tendency can be partially or wholly negated by landing with the heavy wing into the crosswind.

MINIMUM RUNWAY LANDING.

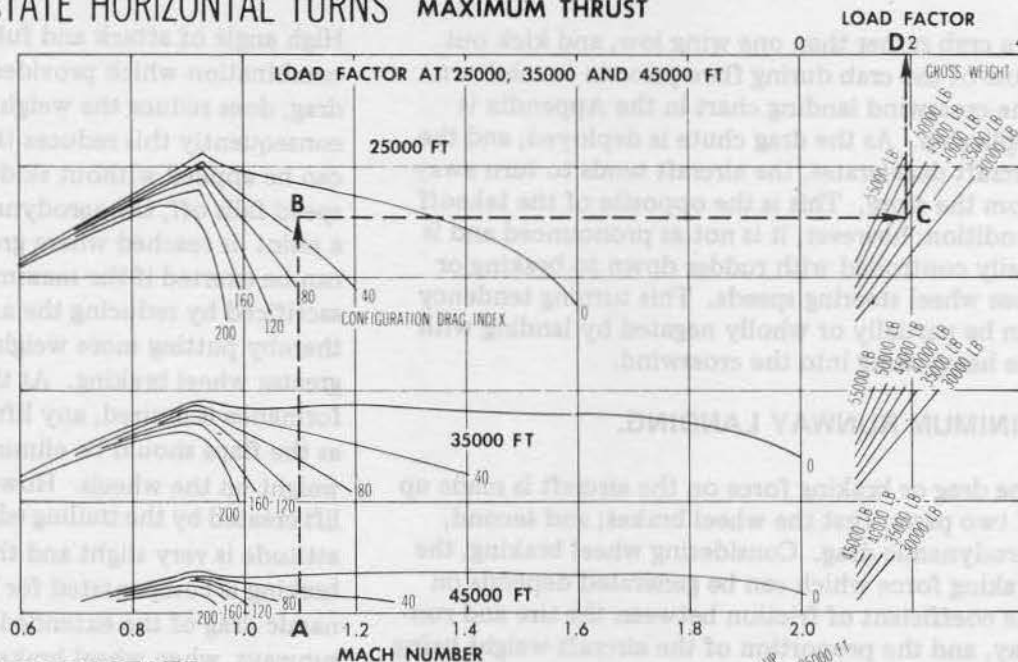
The drag or braking force on the aircraft is made up of two parts: first the wheel brakes; and second, aerodynamic drag. Considering wheel braking, the braking force which can be generated depends on the coefficient of friction between the tire and runway, and the proportion of the aircraft weight being supported by the tire to that still being lifted by the wing. Aerodynamic drag is dependent upon two factors — the attitude and configuration of the aircraft and the indicated airspeed. The minimum landing distance on runways of different coefficients of friction requires different techniques. On runways which have a high coefficient of friction (dry) the best performance will be realized by maximum dependence on the wheel brakes. On a slippery runway (wet), with a low coefficient of friction, the wheel brakes are less effective and the best results can be realized from greater utilization of aerodynamic braking. The high speed portion of the ground roll is the time to utilize aerodynamic braking since the indicated airspeed is high with consequently high aerodynamic drag for effective braking. The drag chute is particularly effective in this speed range. The drag chute absorbs about 60 percent of the total energy of a normal landing.

High angle of attack and full trailing edge flaps, the combination which provides maximum aerodynamic drag, does reduce the weight on the main wheels and consequently this reduces the wheel braking which can be applied without skidding the tire. As the airspeed falls off, the aerodynamic drag decreases and a point is reached where greater total braking force can be exerted if the maximum aerodynamic drag is sacrificed by reducing the angle of attack and lift, thereby putting more weight on the main gear for greater wheel braking. At this point, if maximum performance is desired, any lift increasing devices such as the flaps should be eliminated to get maximum weight on the wheels. However, in the F-105, the lift created by the trailing edge flaps in the three point attitude is very slight and the small loss of wheel braking is compensated for by the residual aerodynamic drag of the extended flaps. On wet, slippery runways, when wheel brakes are not effective, an advantage exists in keeping the flaps down to retain the highest aerodynamic drag possible. On dry runways with high coefficients of friction, there is a little net advantage to retracting the trailing edge flaps when the nose is lowered to obtain maximum weight on the wheels for braking, but this advantage will be less than 500 feet and in most cases 100 to 200 feet. Therefore, it is considered that the advantage of a single procedure, resulting in optimum characteristics when the greatest difficulty would be encountered in stopping the aircraft (slippery runway), would more than offset the very slight disadvantage of this single technique on a dry runway. A secondary consideration in the procedure to retain the deflected flaps during the landing roll is that the flaps would not have to be lowered again in case a go-around is required.

STEADY STATE HORIZONTAL TURNS MAXIMUM THRUST

SAMPLE CHART

Not to be used for Flight Planning



MAXIMUM THRUST STEADY STATE HORIZONTAL TURNS.

From these curves load factor, radius of turn and rate of turn in a maximum thrust, constant speed and constant altitude turn can be determined for any configuration drag index at any Mach Number, altitude and gross weight condition.

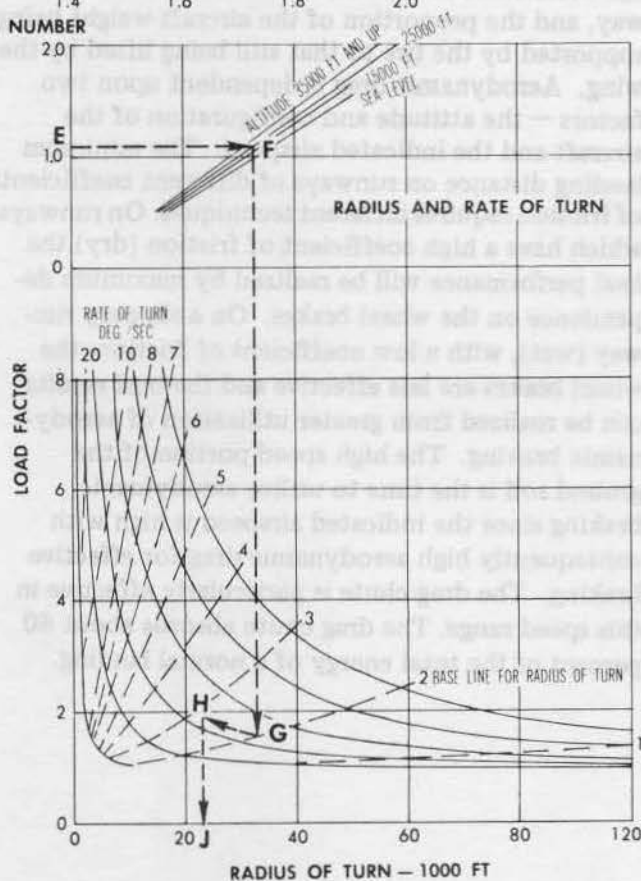
Sample Problem:

Find load factor, radius and rate of turn for the Clean + (2) 450 gal. tanks configuration weighing 40,000 lbs in a steady state maximum thrust turn at 25,000 ft at 1.1 Mach number.

- Determine configuration drag index from figure A1-5,

(1) 450 gal. tank right inboard	14
(1) 450 gal. tank left inboard	14
Configuration drag index	28

- On chart above, enter sample curve at 1.1 Mach number, (A)
- Move up to Drag Index curves for 25,000 ft to configuration drag index 28, (B)
- Move to the right to the line representing 40,000 lbs gross weight, (C)
- Move vertically up to scale and read load factor equal 1.95, (D)
- On chart above, enter sample chart at 1.1 Mach number, (E).
- Move across to 25,000 ft altitude line, (F)



- Drop to base line for radius of turn (G)
- Parallel guide lines to intersect load factor = 1.95 at (H)
- Read rate of turn at (H) = 2.9 degrees/sec. (or $2.9 \times 60 = 1.74$ deg./min).
- Drop to scale and read radius of turn = 23,000 ft at (J)

STEADY STATE HORIZONTAL TURNS

MAXIMUM THRUST

LOAD FACTOR AT SEA LEVEL AND 15000 FT

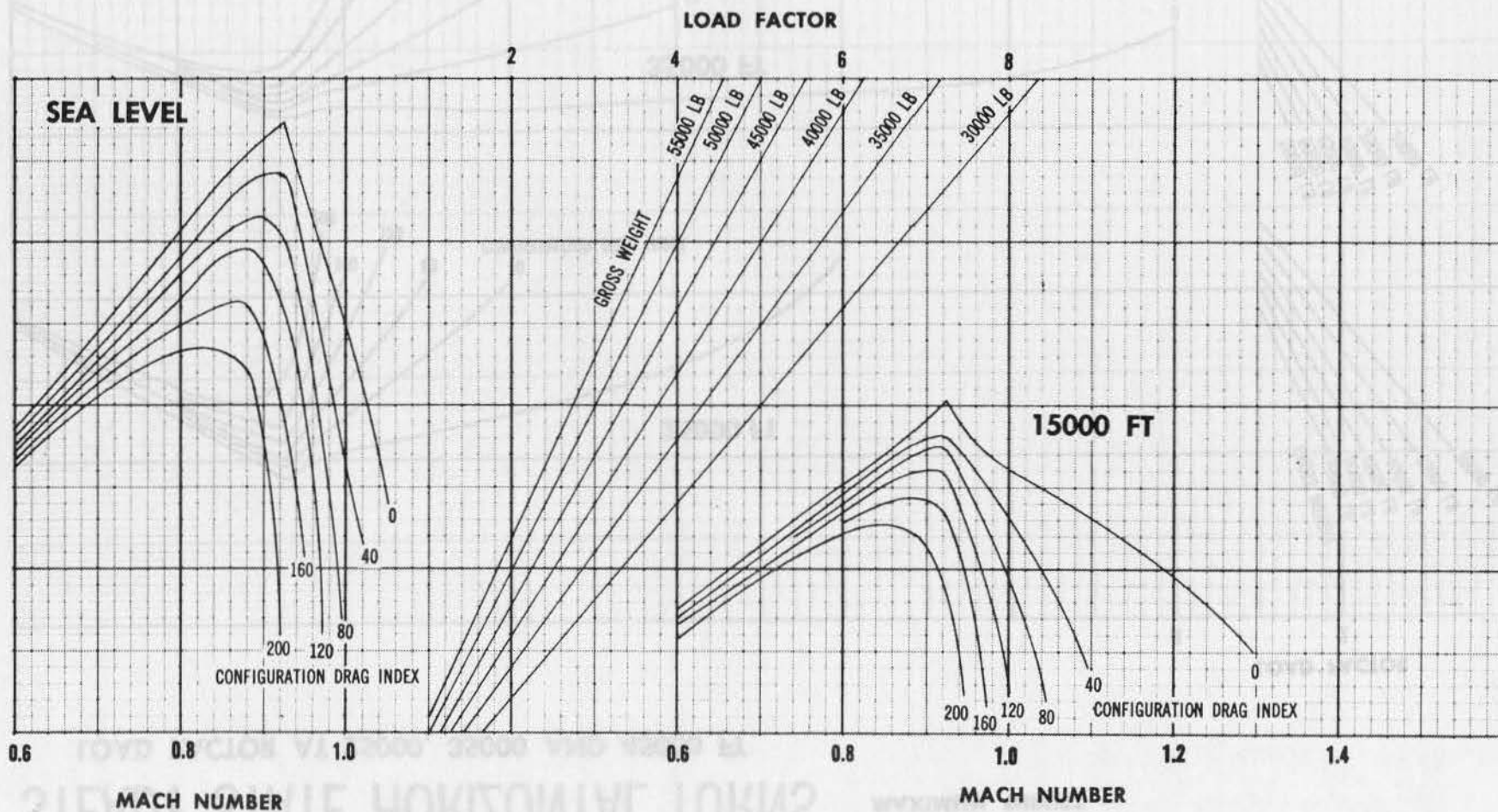


Figure 6-3 (Sheet 1 of 3)

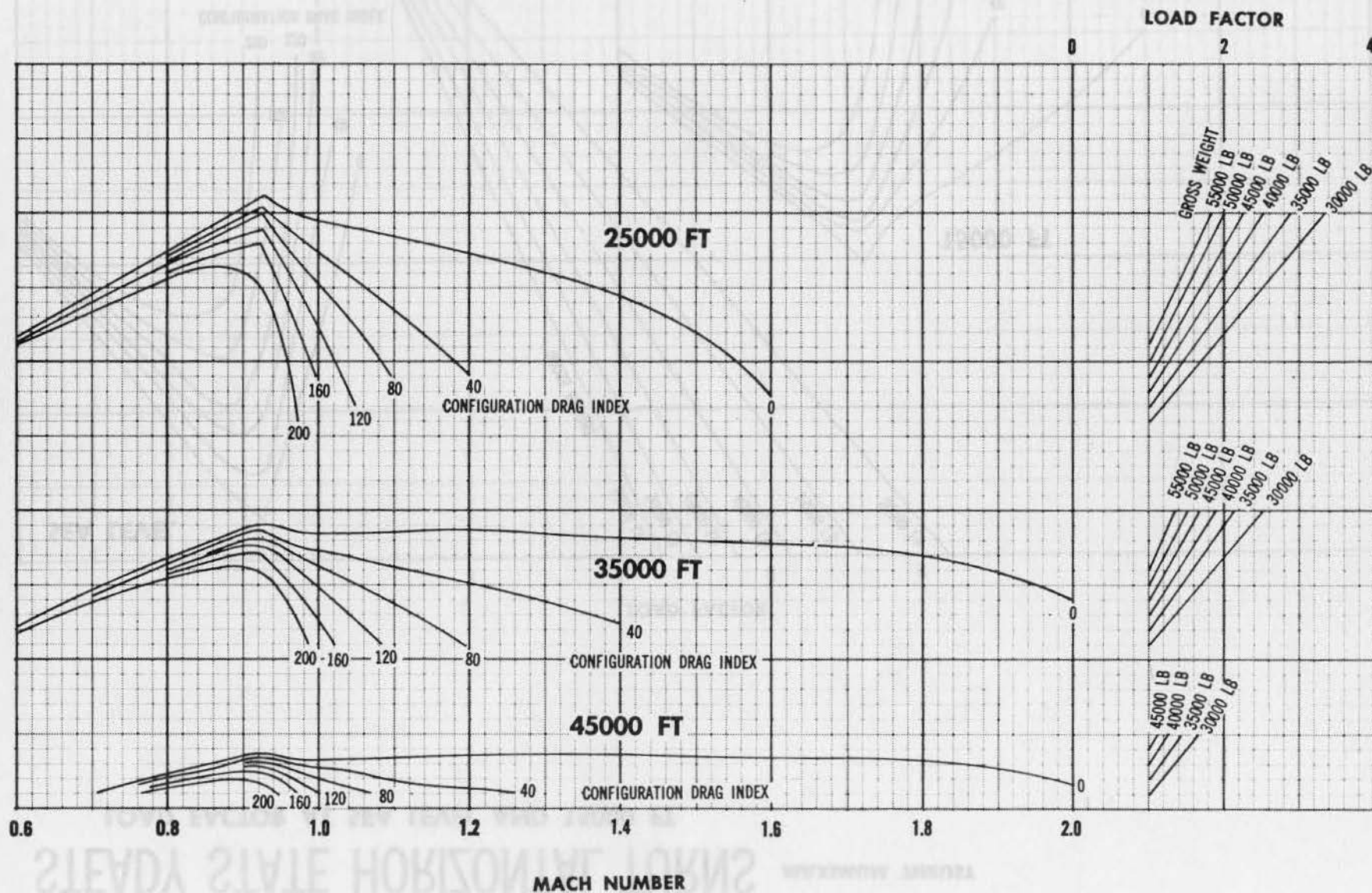
STEADY STATE HORIZONTAL TURNS

MAXIMUM THRUST

LOAD FACTOR AT 25000, 35000 AND 45000 FT

T.O. 1F-105D-1

Figure 6-3 (Sheet 2 of 3)



STEADY STATE HORIZONTAL TURNS

RADIUS AND RATE OF TURN

MAXIMUM THRUST

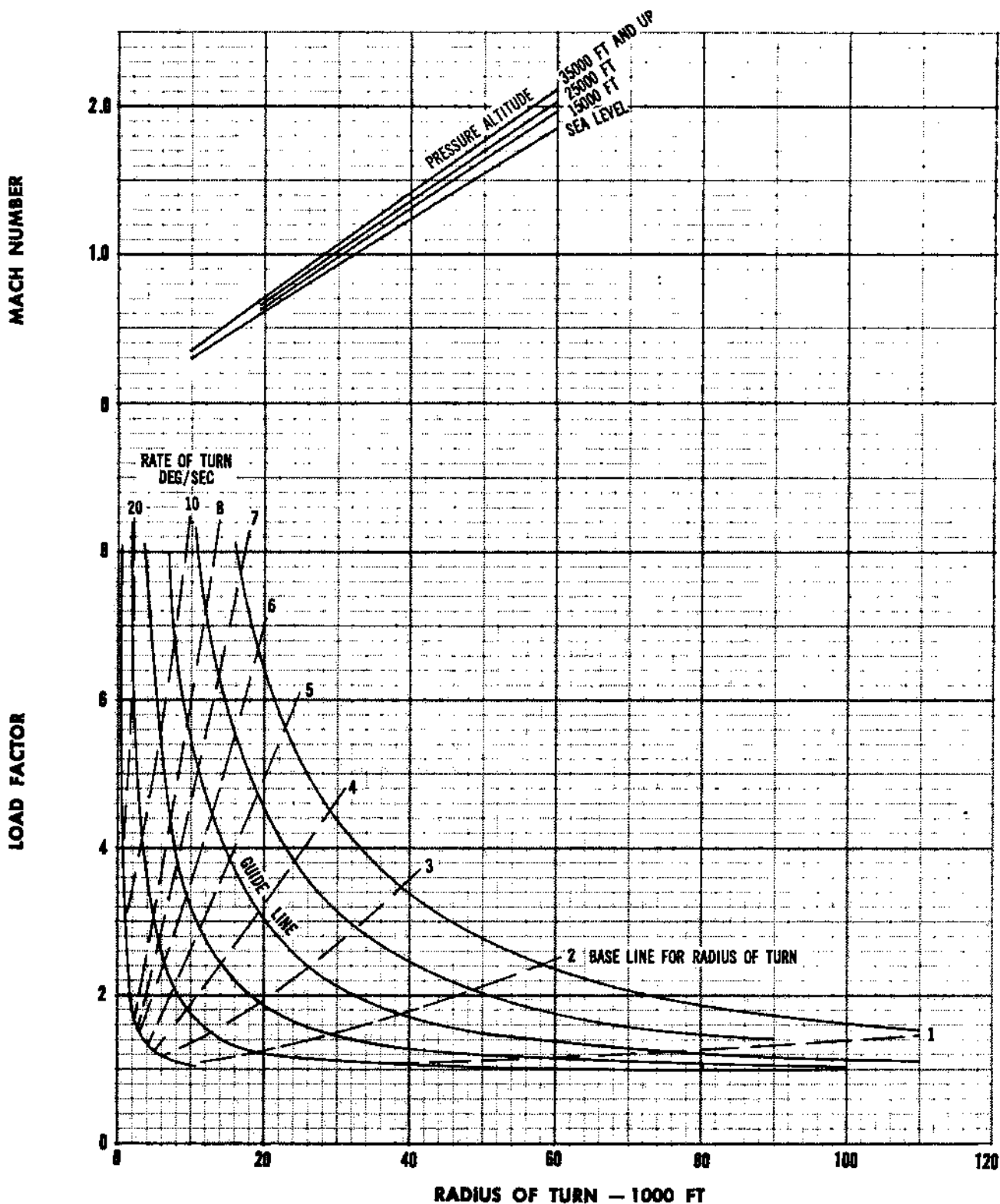
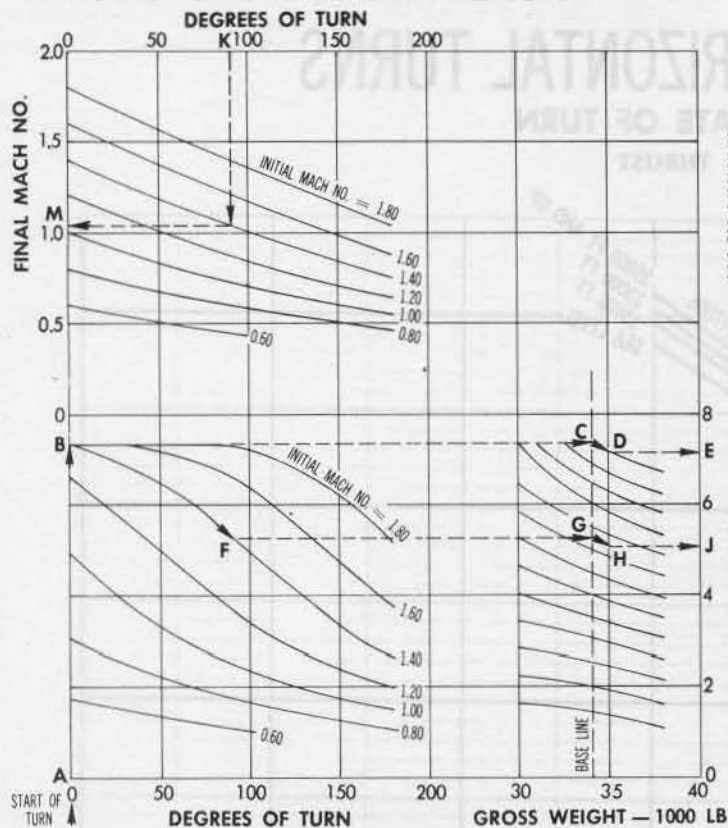


Figure 6-3 (Sheet 3 of 3)

MAXIMUM G TURNS AT CONSTANT ALTITUDE (30000 FEET)



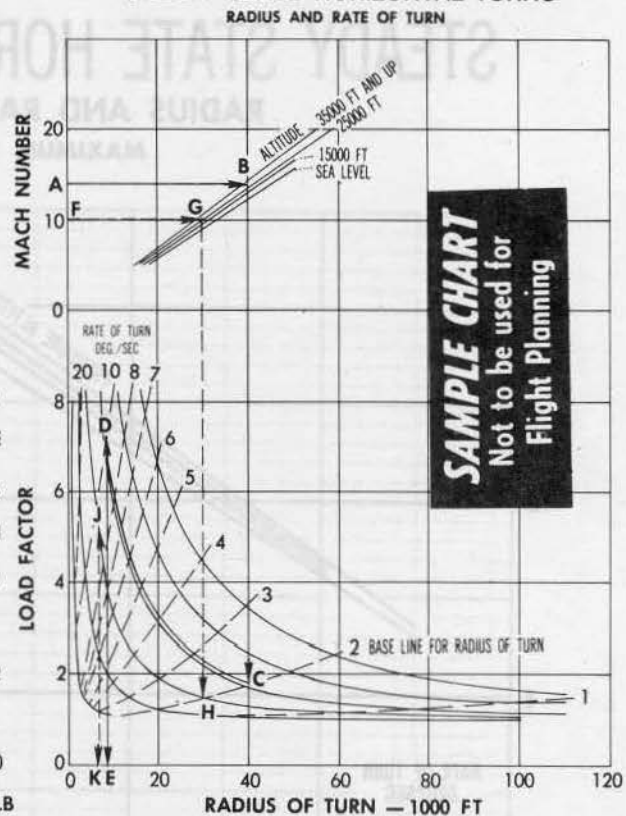
MAXIMUM G TURNS AT CONSTANT ALTITUDE.

Maximum load factors obtainable and Mach No. loss encountered through 180° of turn in level flight (at S.L. 10,000, 20,000, 30,000 and 40,000 ft pressure altitudes) are shown for various initial speed conditions for the clean aircraft. Once the load factor and Mach Number have been determined from these curves for any required turn, radius and rate of turn can be read from the Steady State Radius and Rate of Turn chart on page 6-15).

Example:

1. On chart above, enter sample curve at Start of Turn, (A) and move up to initial Mach No. = 1.4, (B).
2. Move horizontally to weight base line (C), follow guide lines to Gross Weight = 35,000 lbs, (D) and move to the right to the load factor scale to read initial load factor = 7.13 g's, (E).
3. From (B) move along 1.4 Mach No. line to 90° of turn at (F).
4. Move horizontally to weight base line, (G), follow guide lines to Gross Weight = 35,000

STEADY STATE HORIZONTAL TURNS



SAMPLE CHART
Not to be used for
Flight Planning

lbs, (H) and horizontally to the scale to read final load factor = 5.05 g's, (J).

5. Enter upper scale at 90° turn, (K), drop down to Initial Mach No. = 1.4 line, (L), and move left to the scale to read final Mach No. = 1.03, (M).
6. Enter sample radius and rate of turn curve at initial Mach No. = 1.4, (A) and final Mach No. = 1.03, (F). Move horizontally to 30,000 ft pressure altitude, (B) and (G) and vertically to radius of turn base line at (C) and (H), following solid lines for initial conditions and broken lines for final conditions.
7. Follow guide lines to intersect initial load factor = 7.13 at (D) and final load factor = 5.05 at (J). Rates of turn are read at (D) and (J) as approximately 10 deg/sec. (initial) and 9 deg/sec (final), respectively.
8. Drop from (D) and (J) to radius of turn scale and read radii of turn = 8300 ft (initial) and 6500 ft (final) at (E) and (K).
9. Thus it has been determined that the required 90° maximum g turn can be accomplished with a loss of 0.37 Mach No. (1.4-1.03) at load factors from 7.13 to 5.05 g's. At the average rate of turn of approximately 9.5 deg/sec, the turn will take almost 9.5 seconds ($90^\circ \div 9.5 \text{ deg/sec}$) and the radius of turn will vary from 8300 to 6500 ft.

MAXIMUM G TURNS AT CONSTANT ALTITUDE

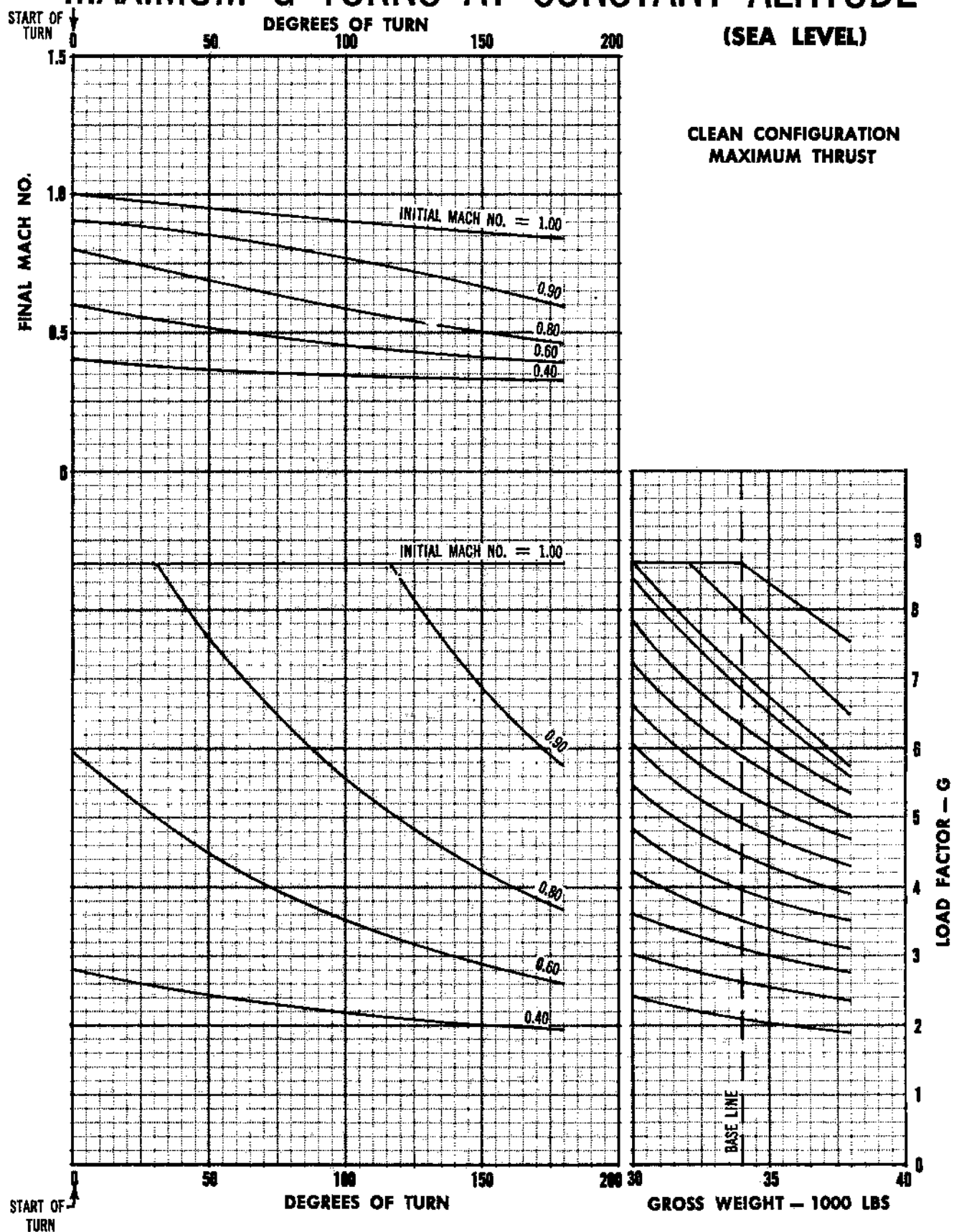


Figure 6-4 (Sheet 1 of 5)

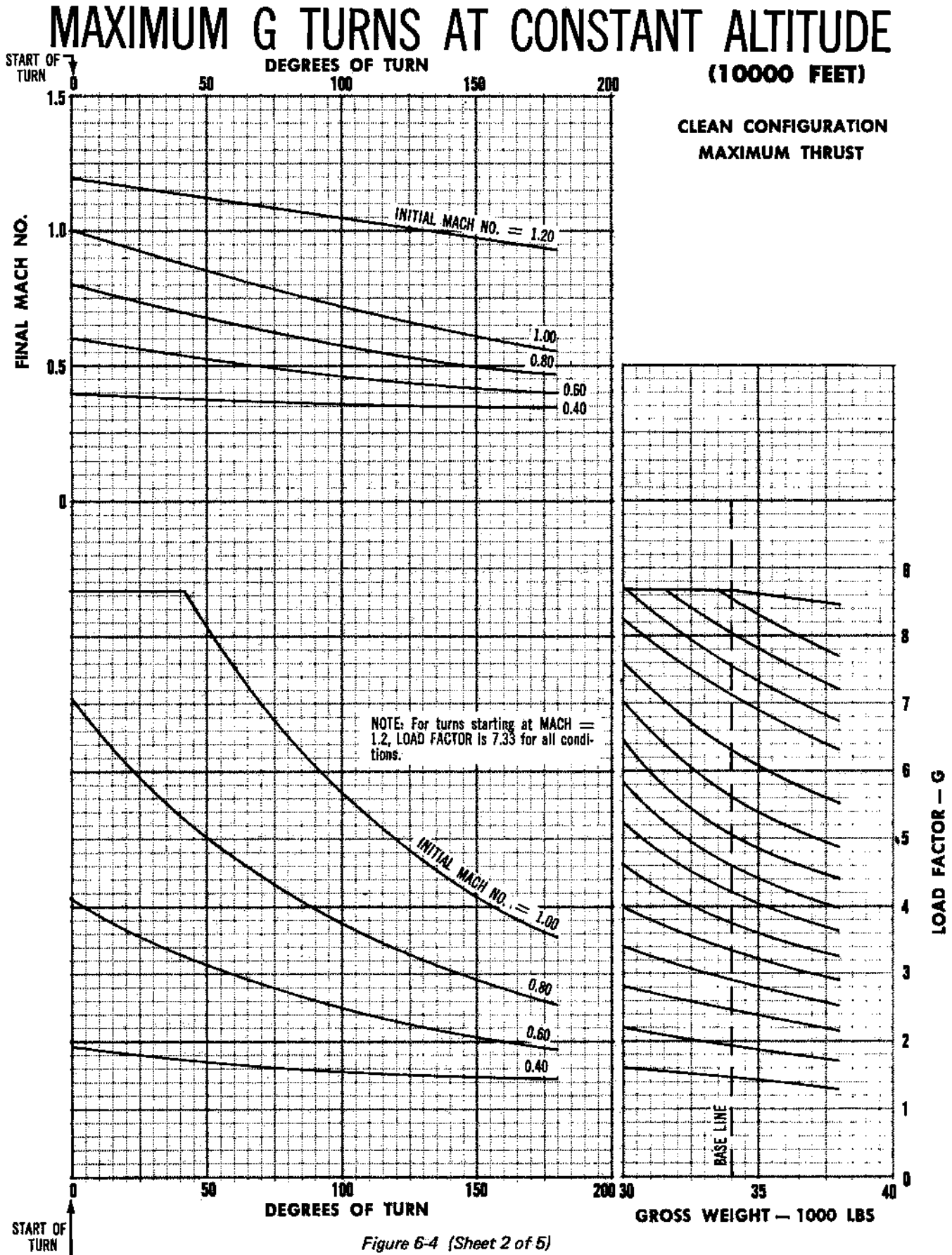


Figure 6-4 (Sheet 2 of 5)

MAXIMUM G TURNS AT CONSTANT ALTITUDE

(20000 FEET)

CLEAN CONFIGURATION
MAXIMUM THRUST

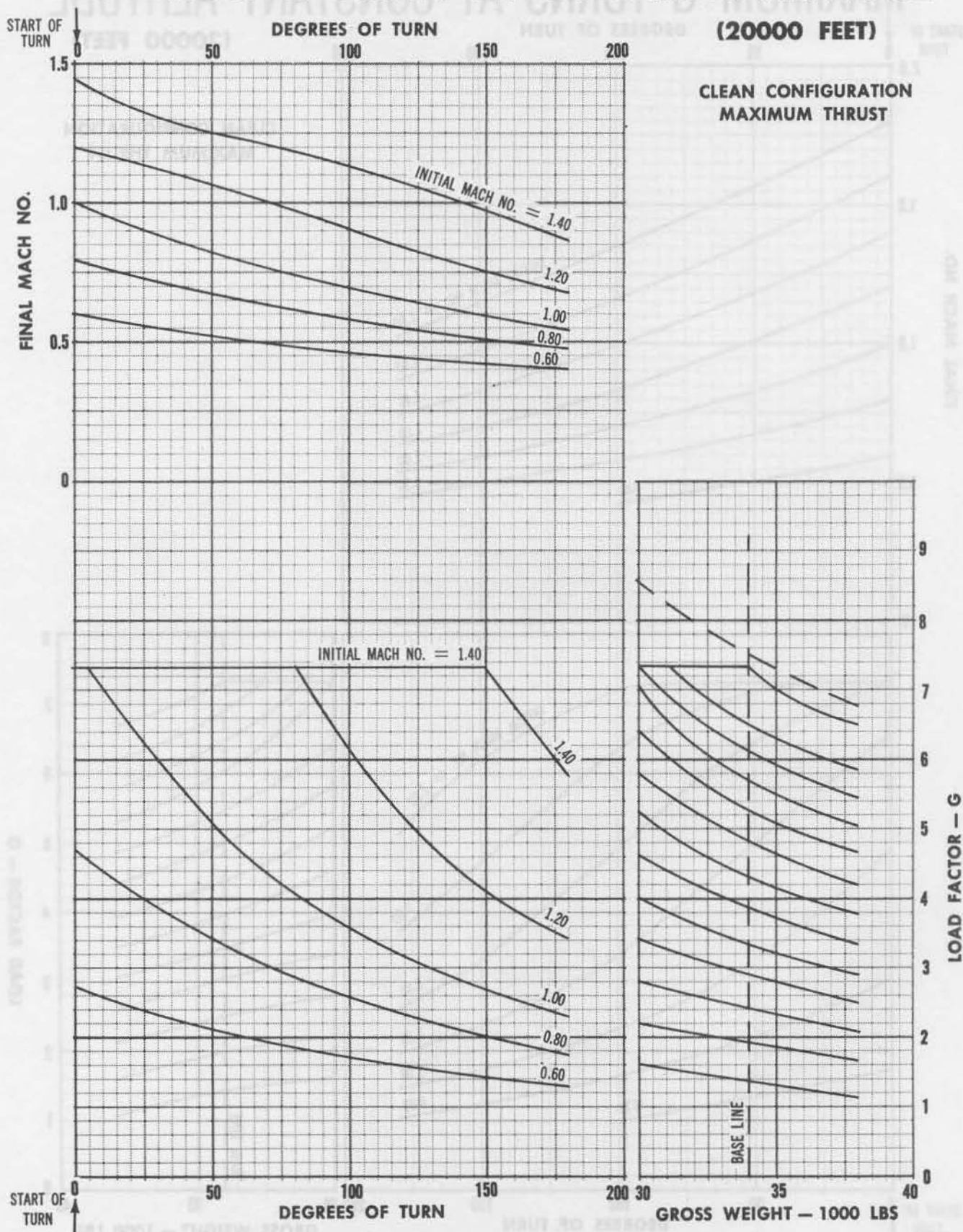
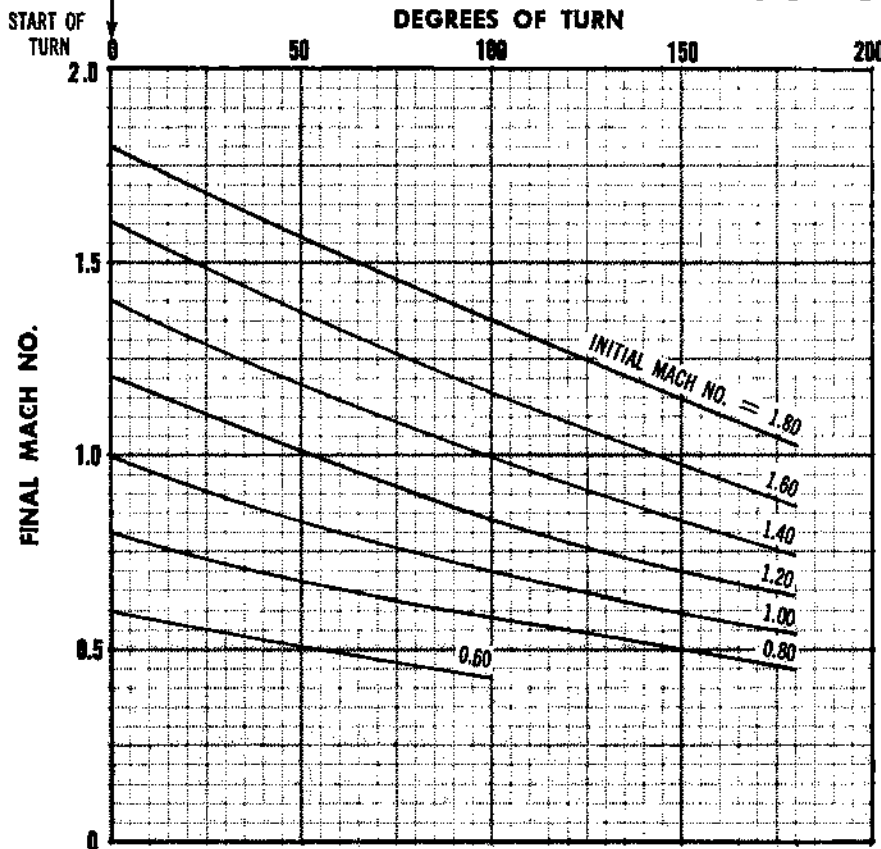


Figure 6-4 (Sheet 3 of 5)

MAXIMUM G TURNS AT CONSTANT ALTITUDE

(30000 FEET)



CLEAN CONFIGURATION
MAXIMUM THRUST

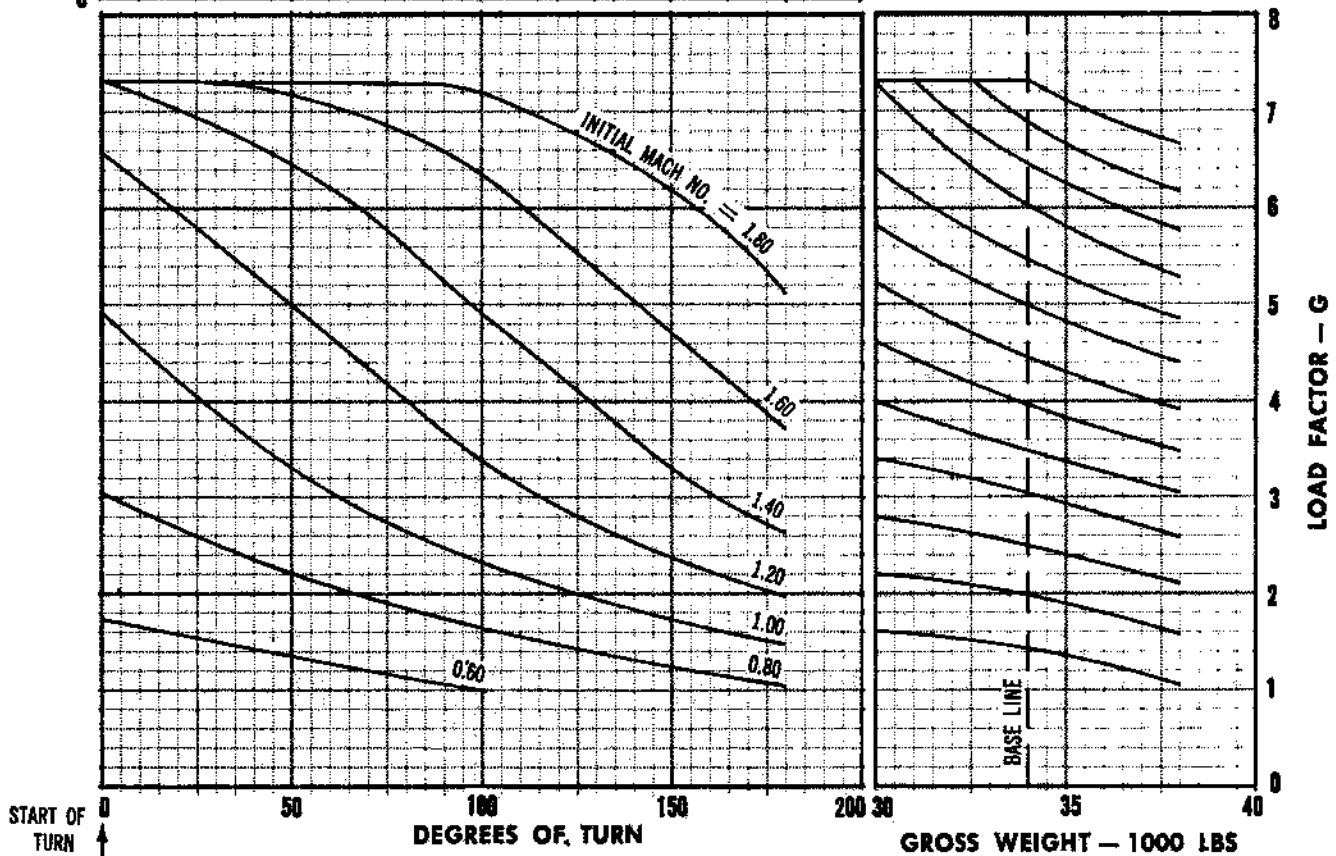


Figure 6-4 (Sheet 4 of 5)

MAXIMUM G TURNS AT CONSTANT ALTITUDE

(40000 FEET)

CLEAN CONFIGURATION
MAXIMUM THRUST

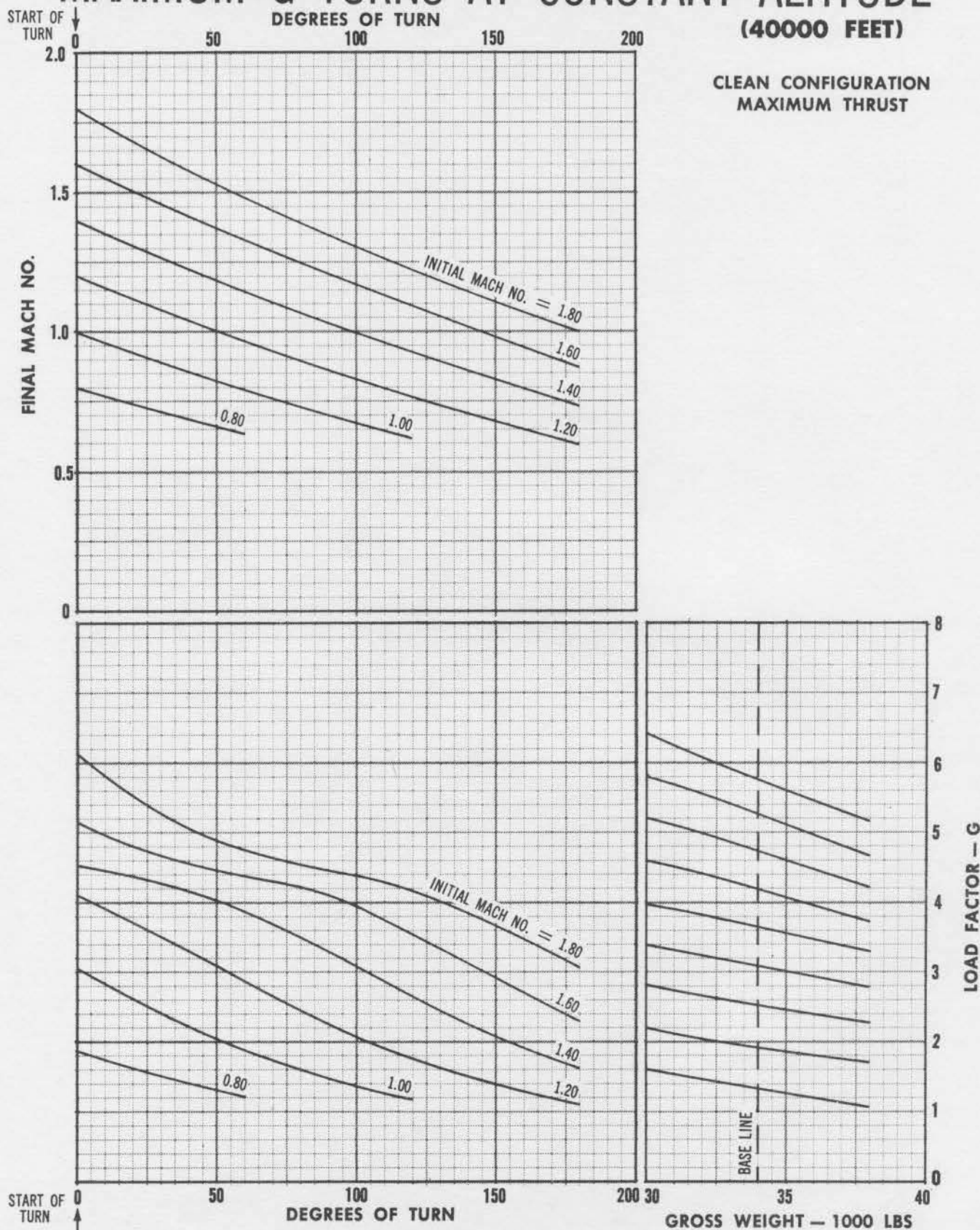


Figure 6-4 (Sheet 5 of 5)

Section VII

ALL WEATHER OPERATION

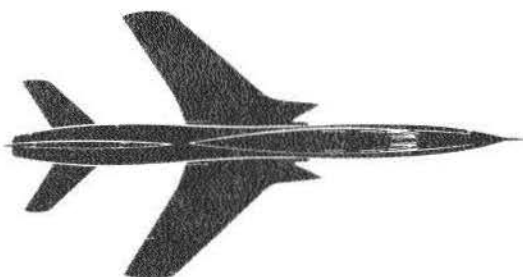


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Except for some repetition necessary for emphasis or continuity of thought, this section contains only those procedures required in instrument flight that differ from, or are in addition to, the normal operating procedures given in section II.

INSTRUMENT FLIGHT PROCEDURES.

The aircraft handles well during all phases of instrument flight. A manually controlled engine anti-icing system is provided. Operation of the windshield defogging system does not clean the windshield of ice entirely. The aircraft operational effectiveness is not restricted, nor are there any control difficulties because of the aircraft rapid acceleration of

lateral control sensitivity. Navigational aids installed in the aircraft are TACAN, Doppler and a UHF direction finder (AN/ARA-48) in addition to all the basic flight instruments. An IFF with the selective identification feature (SIF) is provided to facilitate positive identification by ground radar stations. An autopilot relieves pilot fatigue on long flights and frees him for inflight duties.

BEFORE INSTRUMENT TAKEOFF.

1. Line up visually with centerline of runway.
2. Rotate heading set knob on the HSI until bank steering bar on the ADI centers.
3. Attitude Director Indicator — Set by aligning arrow on pitch trim knob with reference mark.
4. Temperature control lever — Hot or RAM. RAM must be used for water injection takeoff.

CAUTION

If RAM is selected for takeoff, the cockpit temperature knob should be set as high as possible, consistent with pilot comfort. This will prevent the formation of visible vapor when temperature control lever is positioned for cockpit pressurization.

5. Runway Check — Complete.

INSTRUMENT TAKEOFF.

Check completion of all required checklist items. Select appropriate navigational aids to be used for the departure and set navigational controls and switches as required. After aligning the aircraft visually with the runway centerline, check the HSI and magnetic compass against the runway heading. If desired, the bank steering bar may be used for directional information by setting the heading marker under the upper lubber line of the HSI to center the bank steering bar on the ADI. Check that the steering bar (steer needle) switch is set ON. Set ADI by aligning the arrow on the pitch trim knob with the reference mark. This setting, in taxi attitude, should show an attitude of approximately 2 degrees nose up. Thus, the ADI will provide a picture of the aircraft's inflight attitude relative to a level flight condition at normal cruise airspeeds. Follow normal takeoff procedures, maintaining directional control with brakes or nosewheel steering until 60 KCAS when the rudder becomes effective.

CAUTION

Insure that the nose wheel is aligned properly before releasing brakes. Disengage nose wheel steering at 60 KCAS because nose wheel steering is extremely sensitive at high speeds.

- Maintain the heading by reference to the HSI, the bank steering bar and whatever outside reference is available during the takeoff roll. At approximately 5 knots below rotation speed, rotate from the 2 degrees nose-up indication on the ADI to a takeoff attitude of approximately 10 degrees nose high indication on the ADI. At this attitude, the aircraft becomes airborne at takeoff airspeed. As the aircraft leaves the ground, maintain the pitch and bank attitude on the ADI until a definite climb is indicated by the altimeter and vertical velocity. When definitely airborne, retract the gear (observe landing gear limit speeds) and climb at 1500 FPM.

Note

Aft CG configurations will cause the takeoff rotation to be more sensitive and the aircraft will feel as though it is flying off the runway by itself. With an aft CG condition, smooth pitch control inputs must be made during takeoff rotation as well as throughout flight.

- At 240 KCAS place the flap lever to CRUISE & MANEUVER. As flaps retract, increase pitch 2 degrees to maintain 1500 FPM climb. At 300 to 350 KCAS adjust throttle to Military thrust and accelerate to the recommended climb schedule.

INSTRUMENT CLIMB.

The optimum Military Thrust climb schedule recommended in the Appendix is suitable for instrument flight. After the climb schedule is established, the AMI should be used to determine necessary pitch corrections. A maximum bank angle of 30 degrees should not be exceeded during climbing turns except when using the bank steering bar. For instrument departures requiring low altitude maneuvering at low speeds and/or a low rate of climb, use 350 KCAS.

Note

Maximum thrust climbs on instruments are uncomfortable because the steep pitch angle and high acceleration make detection and correction of minor pitch changes difficult. Therefore it is recommended that Military Thrust be used for all climbs under instrument conditions, unless the mission dictates otherwise.

INSTRUMENT CRUISING FLIGHT.

Level Flight.

The aircraft flight characteristics are satisfactory through the normal speed range and present no unusual difficulties in control or handling during instrument flight. Thrust settings and configuration for optimum cruise schedule recommended in the Appendix are satisfactory while using standard instrument techniques. Bank angles should be limited to a maximum of 30 degrees unless bank steering bar is used.

NAVIGATION EQUIPMENT.

A TACAN (AN/ARN-62), a Doppler navigator (AN/APN-131) and the R-14 radar, part of the AN/ASG-19 Fire Control System provides the pilot with reliable and adequate means of navigation. The command radio (AN/ARC-70) provides adequate air-to-air and air-to-ground communication.

HOLDING.

Enter the holding pattern between 20,000 and 30,000 feet at 300 KCAS, whenever possible, with sufficient RPM to maintain 300 KCAS with the flap lever in the HOLD TE FLAPS position. Since 300 KCAS is used for a jet penetration no transition in airspeed is needed from holding to penetrating airspeed. Maximum endurance airspeeds recommended in the Appendix are too low for holding procedures and cause the aircraft to slide to the back side of the power required curve in turns. Holding at 40,000 feet altitude is not recommended because there is no decrease in fuel consumption and aircraft handling characteristics are poor. TACAN, the only airways navigation equipment installed, has a great advantage over other navigation facilities because it has distance measuring equipment (DME) at the same time as azimuth information. TACAN holding patterns are published and in addition, if the traffic situation requires it, any radial and range from a station can be used for a holding pattern fix. To descend in the holding pattern, lower the nose and maintain airspeed.

INSTRUMENT LETDOWNS.

Note

When rain impairs forward visibility during approach, turn on the forward windshield defogging and rain removal systems prior to landing.

Jet Penetration.

If it is desired to descend before reaching the fix, refer to the descent charts in the Appendix for appropriate airspeeds and related information. For information concerning straight line descent at penetration configuration and airspeed, see figure 7-1. Refer to figure 7-2 for typical jet penetration and low approach.

CAUTION

Operation below 90 percent RPM may not supply sufficient heat to keep the engine inlet clear of ice under severe icing conditions. During descent at high airspeeds and low thrust settings, the heat supplied may be inadequate if the ice formation is severe. Under such circumstances increased thrust should be applied to provide more heat.

ILS Approach.

Transition to ILS is normally made as published and clearance for the ILS approach must be obtained prior to reaching the outer marker. Place the instrument selector switch to ILS LOCALIZER during the procedure turn to intercept the localizer course. On straight-in procedures (TACAN/ILS), change the instrument selector switch at the published gate. After intercepting the localizer inbound, set the instrument selector switch to ILS FINAL. When the glide slope indicator starts to move downward (unpegs), prepare to establish a rate of descent. Lower the nose approximately 3 degrees on the ADI. Recommended rate of descent for normal approach speeds is 800 to 1000 feet per minute.

See figure 7-3 for typical ILS Approach and section IV for procedures. Changes in final approach speeds because of changes in gross weight outlined in the Appendix are applicable to ILS approaches. Final approach speed should be stabilized before reaching the glide slope.

CAUTION

Landing gear actuation should not be attempted during a turn. A large nose-up pitching moment will be experienced when landing gear is extended. Immediate nose-down pitch trim change is required.

STRAIGHT-LINE DESCENT

TYPICAL

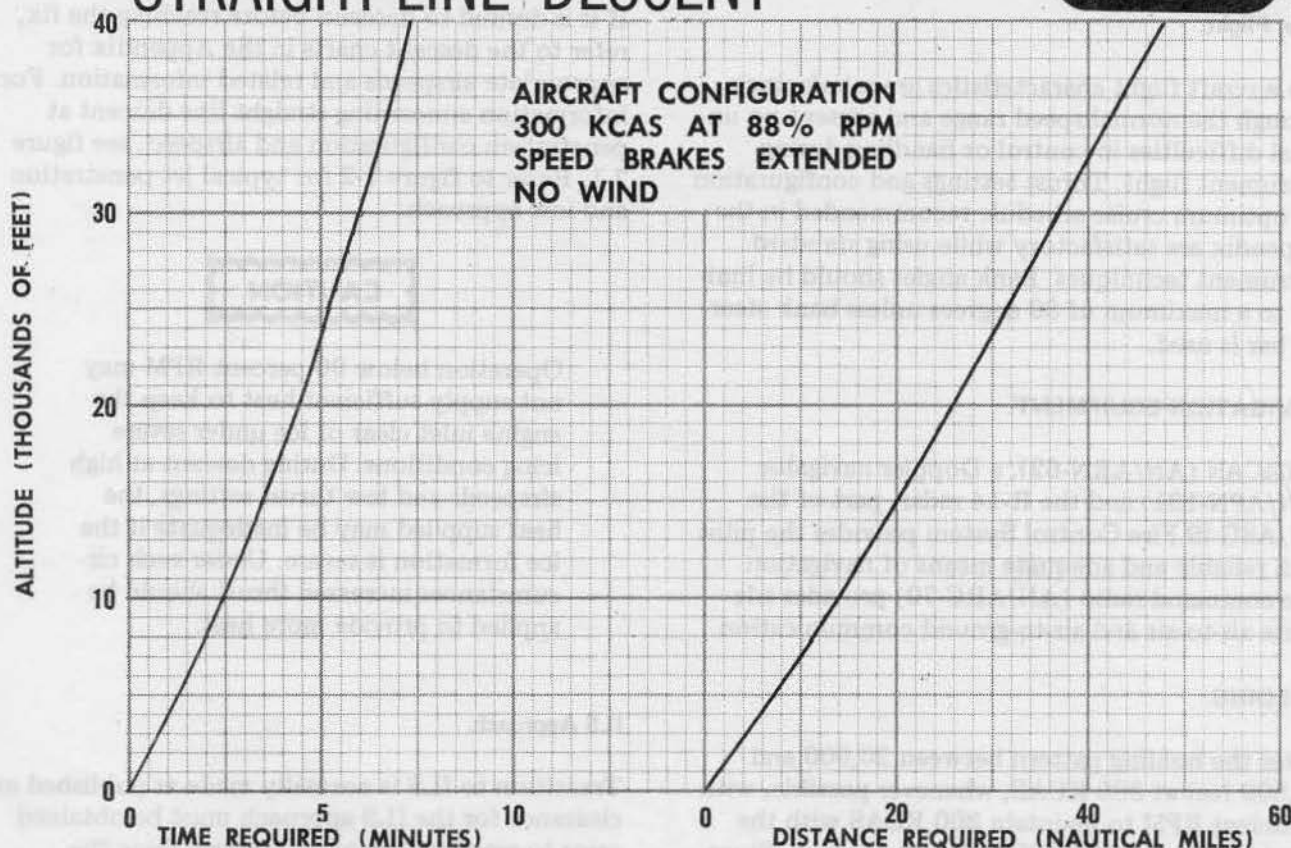


Figure 7-1

Radar Approach.

For Typical Radar Approach see figure 7-3.

CAUTION

Landing gear actuation should not be attempted during a turn. A large nose-up pitching moment will be experienced when landing gear is extended. Immediate nose-down pitch trim change is required.

Missed Approach.

To accomplish a missed approach, advance throttle to Military thrust, retract speed brakes (if extended) as power is applied, and rotate aircraft to takeoff attitude. Establish climb and retract landing gear,

then TE flaps as desired. Allow aircraft to accelerate to 250 KCAS and reduce power to maintain 250 KCAS while climbing to missed approach altitude.

CAUTION

Use of afterburner is not recommended when initiating a missed approach.

ICE AND RAIN.

The aircraft does not have an anti-icing or deicing system for wings or empennage; however, the de-frosting, rain removal, pitot heating, angle of attack sensor vane and engine deicing systems provides protection during flights under icing conditions. Engine anti-icing is most effective at low airspeeds and high thrust settings. Under severe conditions, operating at low thrust settings, or during descent

JET PENETRATION and low approach

TYPICAL

**BEFORE REACHING FIX BEGIN
DESCENT CHECK LIST**

START PENETRATION DESCENT AS PUBLISHED

DESCENT

Flap — HOLD TE FLAPS
RPM — 88 percent
Speed brake switch — OUT
Airspeed — 300 KCAS

CIRCLING APPROACH

LG — DOWN
TE flaps — LANDING & TAKEOFF
Airspeed — 220 KCAS*
Speed brakes — As desired.

MISSED APPROACH

Throttle — Military Thrust
Speed brakes — IN
Establish takeoff attitude
Establish Climb
LG — UP
TE flaps — As desired
Airspeed — 250 KCAS
Execute published missed
approach procedures.

FINAL APPROACH

LG — DOWN
Flaps — LANDING & TAKEOFF
Airspeed — ☐ 188 KCAS*
☐ 193 KCAS*
Speed brakes — As desired

INBOUND

Airspeed — 250 KCAS
Speed brakes — As desired*
TE Flaps — As desired.

PENETRATION TURN

Begin penetration turn as published. Limit angle of bank to 30 degrees, or use bank steering bar (will command approximately 35 degree bank).

LEVEL OFF

Begin level off as desired; observe minimum altitude requirements.

*Airspeeds given are based on a landing gross weight of ☐ 31,500 lb, ☐ 33,500 lb (clean aircraft with B/B tank, two 450-gallon tanks and 2000 lb of fuel).

• Add 3 knots to the speeds for each 1000 lb of additional weight.

• Airspeeds for other gross weights will be found in the Appendix.

TEAR DROP PENETRATION

Initial altitude 20,000 ft
Time 8 min
Fuel 600-700 lb
Distance 20 NMI

Note

Partial trailing edge flaps improves low speed handling characteristics.

Figure 7-2

RADAR/ILS APPROACH

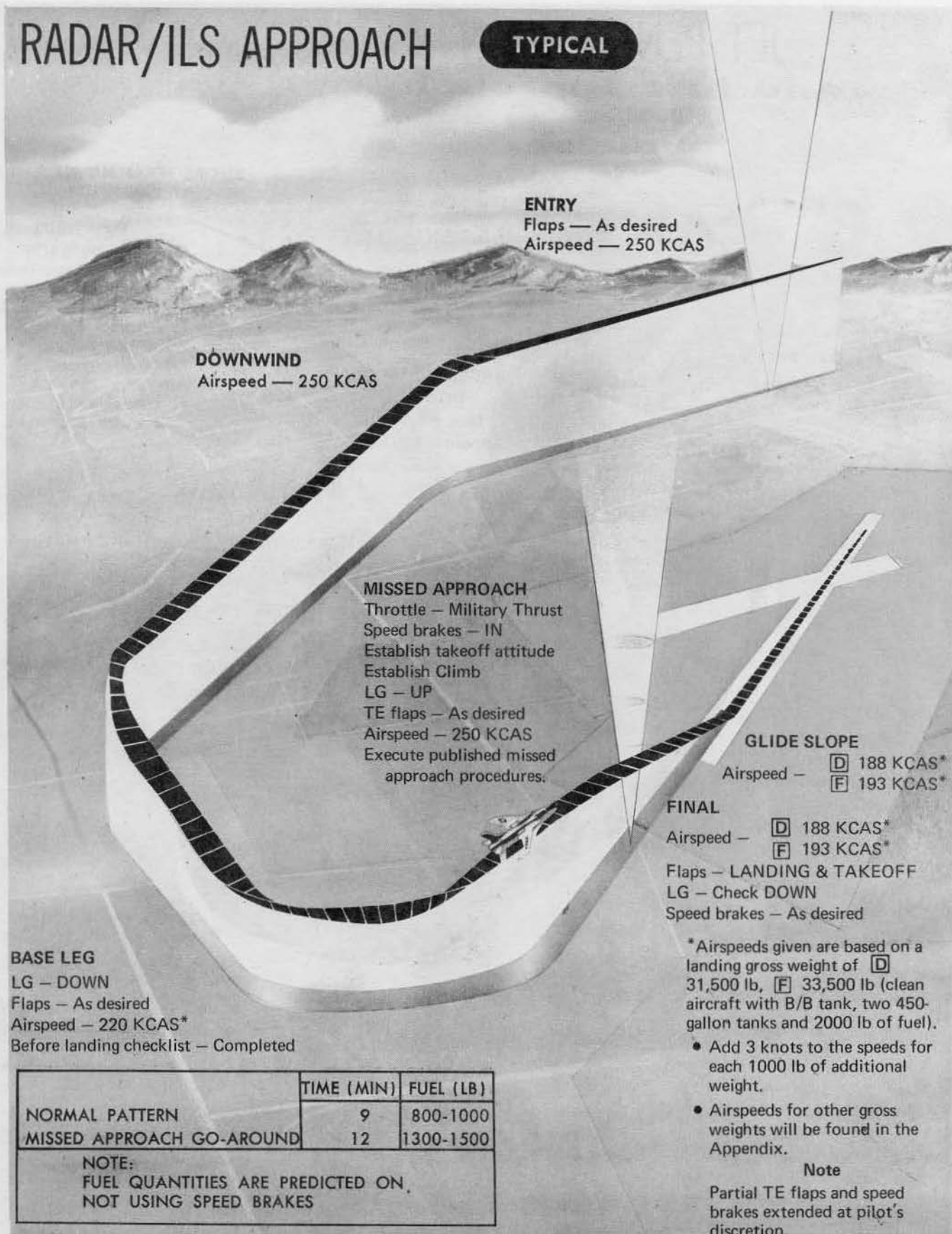
TYPICAL


Figure 7-3

at high airspeeds the heat supplied may not be sufficient to keep the engine inlet clear of ice. Under such circumstances, increased thrust should be applied in order to provide more heat. If ice still accumulates, an abnormal exhaust gas temperature rise will be noted when increased thrust is applied. Airspeed must then be reduced until the icing region has been penetrated.

TURBULENCE AND THUNDERSTORMS.

CAUTION

Flight through thunderstorms should be avoided if at all possible. Hail, encountered, could cause rapid deterioration of the radome and unpredictable aircraft damage.

Flight in areas of turbulent air, hailstorms or thunderstorms, increases the danger of engine flame-out. The following factors, singly or in combination, have caused engine flame-outs:

1. Penetration of cumulus buildups with associated high liquid content.
2. Engine icing of inlet guide vanes.
3. Turbulence associated with penetration can result in angles of attack of plus 9 degrees, or more, causing marginal engine performance.
4. Above 40,000 feet altitude, the surge margin of the engine is reduced, and there is poor air distribution across the face of the compressor.

CAUTION

Flying in turbulence or hail may increase inlet distortion which at higher altitudes can result in engine surge and possible flame-out; however, normal air starts may be accomplished.

During flight in areas of turbulent air, hailstorms, or thunderstorms, the exhaust gas temperature and pressure ratio gages should be monitored continuously. Exhaust gas temperature indication alone may come too late to enable the pilot to take timely corrective action. The best penetration speed

for the aircraft in severe turbulence is 300 KCAS or Mach 0.88, whichever is lower, with leading edge flaps in CRUISE & MANEUVER.

NIGHT FLYING.

Cockpit lighting is adequate for night flying. There are no specific techniques for flying the aircraft at night that differ from those for day flight.

CAUTION

Caution should be used during night formation because of inadequacy of bank-angle detection. Sweep-back of the wings and ratio of wing span to fuselage length cause considerable difficulty in perceiving relative position to lead aircraft.

- With landing lights on, in areas where moisture is present, reflection and glare may limit your forward vision. Caution should be used throughout the landing phase.

Note

Afterburner glare is very pronounced during formation takeoff. Visual acuity may be affected when lead aircraft afterburner is shut off.

COLD WEATHER OPERATION.

The majority of cold weather operating difficulties are encountered on the ground. The following instructions are intended to supplement the normal operating instructions in section II, and should be followed where applicable, when arctic-type weather is encountered.

BEFORE ENTERING THE AIRCRAFT.

Check that all protective covers and duct plugs are removed. Check to see that all ducts are free of snow, frost and ice.

WARNING

Depending on the weight of snow and ice accumulated, takeoff distances and

WARNING (continued)

climb-out performances can be seriously affected. The roughness and distribution of the ice and snow could vary stall speeds and characteristics to an extremely dangerous degree. Loss of thrust shortly after takeoff is a serious enough problem without the added, and avoidable, hazard of snow and ice on the wing. In view of the unpredictable and unsafe effects of such a practice, the ice and snow must be removed before flight is attempted.

Check all drains and vents including fuel tank vents for freedom from ice. Check that all ice and dirt is removed from landing gears, actuating pistons and limit switches.

CAUTION

Make sure that the channels on the upper main gear side-braces are free of snow and ice. If there is an accumulation of snow or ice in this channel, the main landing gear will not fully retract.

Check that landing gear shock struts are clear of ice and dirt. Check shock struts for correct service. (The nose gear shock strut air pressure provides the centering force when the aircraft breaks ground.) Inspect aircraft carefully for fuel and hydraulic leaks caused by contraction of fittings or by shrinkage of packings.

CAUTION

Make sure that electrical power has been applied to the aircraft for at least 5 minutes so that all electronic units with internal heaters are sufficiently warmed for proper operation. For temperature between -31°F and -65°F (-35°C and -54°C) warm-up time for the R14 radar shall be at least 15 minutes.

ON ENTERING THE AIRCRAFT.

To conserve the battery, use external power for starting. No preheat nor special starting procedures are required; however, at temperatures below

-34°C (-30°F), allow engine to idle 2 minutes before accelerating.

CAUTION

Do not turn on the AC generator until the ATM has stabilized.

- Because of low ambient temperatures, the thrust developed at all engine speeds is noticeably greater than normal.

Turn on cockpit heat, forward windshield defogging and side panel defrosting system, as required immediately after engine start.

BEFORE TAXIING. (At temperatures below $+20^{\circ}\text{F}$ [-6.6°C])

Keep oxygen mask well clear of face, until the cockpit has warmed, to prevent freezing the inhalation valves. Check flight controls, stabilizer, rudder, ailerons, flaps, speed brake and trim for proper operation. Complete this check only after fluid has had time to warm, a minimum of 5 minutes after engine start, before cycling controls through full travel. Carefully (slowly) cycle controls two to nine times or as required to obtain a normal operation of hydraulic system.

CAUTION

At temperatures below -20°F (-29°C) precautionary measures should be exercised, including multiple "gentle" cycling of all appropriate hydraulically operated systems until the fluid has had a chance to warm up, or the application of external heat to the hydraulic systems.

TAXIING.**WARNING**

Make sure all instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

The center of gravity of the aircraft is well aft, and there is very little weight on the nose gear; therefore, nose wheel steering is not very effective when taxiing on ice and hard packed snow. A combination of nose wheel steering and braking should be used. The nose wheel will skid sideways easily, and it may be possible to roll the tire off the rim. Exercise care at all times while operating on these surfaces, and reduce taxi speeds. Increase the normal interval between aircraft to insure safe stopping distance and prevent icing of aircraft surfaces by melted snow and ice in the jet blast of a preceding aircraft. Minimize taxi time to conserve fuel and reduce the amount of ice-fog generated by the engine. If the aircraft has been taxied down the runway, this fog may delay takeoff by lowering the visibility below takeoff minimum. If bare spots exist through the snow, skidding the tires onto them should be avoided. Tire pressures should be watched closely. Flat spots aggravate gear-walking tendencies.

TAKEOFF.

The afterburner should not be engaged until the aircraft is rolling straight down the runway and nose wheel steering engaged. Release the nose wheel steering at rudder effective speed (approximately 60 knots CAS) and maintain directional control throughout the remainder of the ground roll with the rudder. Particular care is required to avoid exceeding climb schedule speeds because of the additional thrust available at low temperatures.

DESCENT.

Turn on windshield and side panel defrosting system 2 minutes before any rapid descent, to provide preheating, and prevent fogging and frosting of the windshield.

LANDING.

The drag chute should be deployed as soon as practical after touchdown on every landing in cold temperatures. The nose should be held high after touchdown for as long as possible, to derive the maximum benefit from aerodynamic braking. Speed brakes should be opened fully before, or immediately after, touchdown. If the aircraft starts to skid sideways, the brakes should be released until it straightens. Nose wheel steering is of little use until slow speeds are reached. The hot tires will skid even more easily than during preflight taxiing.

ENGINE SHUTDOWN.

Shut down the engine in the normal manner.

BEFORE LEAVING THE AIRCRAFT.

Release the brakes after the wheels are chocked, and leave the canopy partly open, to allow circulation within the cockpit to prevent canopy cracking from differential contraction, and to reduce windshield and canopy frosting.

DESERT AND HOT WEATHER PROCEDURES.

Hot weather and desert procedures differ from normal procedures, mainly in that additional precautions must be taken to protect the aircraft from damage caused by high temperatures and dust. Particular care should be taken to prevent the entrance of sand into the various aircraft parts and systems (engine, fuel system, pitot-static systems, etc.). All filters should be checked more frequently than under normal conditions. Units with plastic or rubber parts should be protected as much as possible from windblown sand and excessive temperatures. Tires should be checked frequently for signs of blistering or cord separation. Canopy covers should be left off, to prevent sand between the cover and the canopy acting as an abrasive on the plastic. Heat build-up under closed canopy will not damage cockpit at runway temperatures of 110 degrees or less.

BEFORE ENTERING AIRCRAFT.

1. Check exposed portions of shock strut pistons for dust and sand and have them cleaned if necessary.
2. Check inflation of shock struts and hydraulic accumulators which may have become overinflated because of temperature increases.
3. Check tires carefully for blistering or cord separation, and be sure all protective covers are removed from aircraft.
4. Check intake duct for accumulations of dust or sand.
5. Make sure all filters have been cleaned, and that the aircraft has been thoroughly inspected for fuel or hydraulic leaks caused by the swelling of packings or expanding of fittings.

6. Inspect area behind aircraft to make sure sand or dust will not be blown onto personnel, or equipment, during starting operations.

ON ENTERING AIRCRAFT.

1. Check cockpit for accumulation of dust or sand.
2. Check instruments and controls for moisture from high humidity, and ground-heat them, if necessary, to dry them.

GROUND OPERATION.

The electronic cooling system adequately cools the electronic equipment for hot atmospheres up to 103°F (39.4°C). For ground operation prior to takeoff, where the ambient temperatures are above 103°F (39.4°C), the electronic cooling blower must be operated for 5 minutes before supplying electrical power to the CIN, Doppler, Thunderstick or the R-14 Radar.

Note

The 5 minute cooling period for temperatures above 103°F (39.4°C) can be neglected for aircraft on alert status. The Doppler and the R-14 Radar should not be turned on during the BEFORE TAXIING check unless takeoff will be

accomplished within approximately 5 minutes. Due to the extra load on the cooling blower, the Doppler and the radar should be turned on during the BEFORE TAKING RUNWAY check.

BEFORE TAKEOFF.

Limit use of brakes as much as possible, because brake cooling is reduced when outside air temperatures are high.

TAKEOFF.

CAUTION

To prevent additional drag caused by excessive angle of attack, the nose should not be rotated prior to rotation speed, as shown in Appendix I.

DURING FLIGHT.

The windshield and side-panel defrost system should be operated at the highest possible temperature (consistent with the pilot's comfort) during high altitude flight, if the humidity is high, to preheat the transparent surfaces, precluding the formation of frost or condensation during a rapid descent. In desert flying with very low humidity, this precaution is not necessary.

Appendix I

PERFORMANCE

DATA



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Note

All charts with reference to [947] N/C/W or subsequent to [947] C/W are being revised to reflect compliance with [947]. [947] has been complied with on all aircraft in the inventory.

These charts will be published when the revised data is developed.

INTRODUCTION

Appendix I is divided into parts (1 through 10) to present performance data in proper sequence for preflight planning. The requirements for carriage of a large number of different kinds of external stores on the F-105 aircraft have made the presentation of performance data for specific configurations in the Flight Manual impractical. Accordingly the charts presented in this Appendix may be

used to determine the performance for the aircraft in any configuration of required external stores. Data on each chart is presented for drag indices ranging from a drag index of 0 for the clean aircraft [947] N/C/W with no external stores to a drag index of 200. Each external store, for which a requirement has been established for the aircraft, has been assigned a drag number. The configuration drag index for a given configuration is the sum of the store drag numbers.

ABBREVIATIONS

A/B	Afterburner	Max	Maximum
Alt	Altitude	MER	Multiple Ejector Rack
AMI	Airspeed Mach Indicator	Min	Minute(s)
AVVI	Altitude — Vertical Velocity Indicator	MPH	Miles per hour
B/B	Bomb Bay	Naut Mi	Nautical Mile(s)
°C	Degrees Centigrade	N/C/W	Technical Order not Complied with
CAS	Calibrated Airspeed	N Mi	Nautical Mile(s)
Config	Configuration	No.	Number
Cont	Continuous	O.A.T.	Outside Air Temperature
CR-CL	Cruise Climb	Outb'd	Outboard
CU ft	Cubic feet	PSI	Pounds per Square Inch
C/W	Technical Order complied with	R/A	Radius of Action
Dist	Distance	RCR	Runway Condition Reading
°F	Degrees Fahrenheit	RPM	Revolutions per minute
FPM	Feet per minute	Sec	Second(s)
Ft	Feet	SL	Sea Level
Gal	Gallon(s)	Sq ft	Square feet
Hr	Hour(s)	Std	Standard
IAS	Indicated Airspeed	TAS	True Airspeed
ICAO	International Civil Aviation Organization	TE	Trailing Edge
IFIS	Integrated Flight Instruments System	Temp	Temperature
In Hg	Inches of Mercury	T.O.	Takeoff
Inb'd	Inboard	Wt	Weight
KCAS	Knots Calibrated Airspeed	ΔM	Mach number increment
KIAS	Knots Indicated Airspeed	ΔH	Altitude increment
KTAS	Knots True Airspeed	ΔV	Airspeed increment
Lb	Pound(s)	δ	Delta: ratio of ambient air pressure to standard sea level air pressure
LE	Leading Edge	σ	Sigma: ratio of ambient air density to standard sea level air density
M	Mach number		

DEFINITION OF TERMS

Acceleration Check Distance: distance to the runway marker which is 2000 feet short of the go, no — go distance.

Acceleration Check Speed: minimum speed at the acceleration check marker.

Afterburner: aft section of the engine in which fuel is burned to augment the engine thrust.

Airspeed: the speed of the aircraft relative to the air through which it is moving.

Ambient Conditions: conditions of the air surrounding the aircraft at any given time under consideration.

Calibrated Airspeed: indicated airspeed corrected for position error; or indicated tape airspeed corrected for cam error.

Centerline MER Pylon: a pylon designed to carry a multiple ejector rack at the centerline pylon station.

Climbout Index: an index based on takeoff thrust setting and ambient conditions, used to determine climbout performance after takeoff.

Combat Ceiling: highest pressure altitude at which the aircraft can climb at the rate of 500 FPM.

Compressibility Error: an error in the airspeed indicator reading and the outside air temperature indicator reading caused by air being compressed by the moving aircraft.

Configuration Drag Index: the sum of the clean aircraft configuration drag index, the store drag numbers of external stores carried and the incremental drag number for lateral trim if the external stores are asymmetrical in weight, used to define the inflight performance of the aircraft so configured.

Cruise Ceiling: highest pressure altitude at which the aircraft can climb at the rate of 300 FPM with maximum continuous thrust.

Cruise Climb: the method of achieving maximum long range cruise performance by continually increasing cruise altitude as gross weight decreases.

Cruise Climb Altitude: the pressure altitude for a given configuration at a given gross weight at which maximum long range cruise is achieved.

Cruise Factor: a factor based on aircraft gross weight, configuration, cruise pressure altitude and cruise speed, used to determine cruise performance.

Density Altitude: the altitude obtained from a standard density altitude chart for any combination of pressure altitude and temperature, or for any density ratio factor ($1/\sqrt{\sigma}$).

Direct Loaded Pylon: pylon designed to carry a single weapon without racks, adapters, etc.

Diversion Summary: a chart showing distance (Diversion Range Summary) or time (Diversion Endurance Summary) available for various flight plans with small amounts of fuel on board at various pressure altitudes.

Equivalent Airspeed: calibrated airspeed corrected for compressibility.

Equivalent Gross Weight: aircraft gross weight times the load factor required to maintain a given bank angle.

Entry Gross Weight: a gross weight scale which relates maximum thrust acceleration performance to initial acceleration gross weight.

Go, No—Go Distance: distance traveled in reaching the last runway marker short of the refusal distance.

Go, No—Go Speed: minimum speed at the go, no—go marker.

Go, No—Go Tolerance: maximum speed deficiency that is acceptable at the go, no—go point to ensure a safe takeoff in 90% of the available runway.

Ground Speed: the speed of the aircraft relative to the ground over which it is flying. Under zero wind conditions, ground speed equals true airspeed.

Inches Hg: a measure of air pressure which compares it to the weight of a column of mercury.

Indicated Airspeed: standby airspeed indicator reading corrected for mechanical instrument error but uncorrected for position error.

Indicated Tape Airspeed: AMI airspeed reading uncorrected for cam error.

Long Range Cruise Speed: the higher speed for 99% maximum range at which it is recommended to fly the aircraft when range is of more concern than time.

Maximum Continuous Thrust: the highest thrust setting allowable for continuous operation.

Maximum Thrust: military thrust augmented by afterburning; limited to 15 minutes continuous operation inflight and 20 seconds on the ground.

Military Thrust: maximum non-augmented thrust; limited to 30 minutes continuous operation in flight and 5 minutes on the ground.

Minimum Afterburner Blow-out Speed: the lowest speed to which the aircraft can accelerate with maximum thrust, experience an afterburner failure, and then complete the takeoff with military thrust without exceeding the available runway length.

Multiple Weapon Pylon: a cast magnesium pylon, trailing edge swept aft from wing to store, designed to carry a single nuclear weapon, a single conventional weapon or a multiple ejector rack at the centerline or inboard pylon stations.

Nautical Miles per Pound: the number of air nautical miles traveled while consuming a pound of fuel.

Position Error: the error in the airspeed indicator reading and the altimeter reading caused by the inability of the static orifices to experience the true ambient air pressure.

Pressure Altitude: the altitude obtained from a standard atmosphere table for any given value of air pressure. This is the altitude that an altimeter will show (after correcting for position error) when the barometric pressure at sea level is 29.92 inches Hg.

Receiver Factor: a factor based on receiver gross weight, configuration, refueling altitude and refuel speed, used to obtain refueling factor.

Refueling Factor: the sum of receiver and tanker factors, used to determine receiver fuel consumption during inflight refueling.

Refusal Distance: the distance required to accelerate to the refusal speed.

Refusal Speed: maximum speed to which the aircraft can accelerate and then stop in the available runway length.

Rotation Speed: airspeed at which the nose wheel leaves the runway.

Runway Condition Reading: the number portion of a system of reporting surface conditions at terminal airfields, related to the effectiveness of braking on the runway.

Specific Range: nautical miles per pound of fuel.

Standard Atmospheric Conditions: an arbitrarily selected set of atmospheric conditions chosen to approximate the average atmosphere of the world.

Standard Day: a day on which standard atmospheric conditions are assumed to exist.

Store Drag Number: a number related to the incremental drag of an externally mounted item, used to determine the configuration drag index.

Takeoff Index: an index based on takeoff thrust setting and ambient conditions, used to determine takeoff performance.

Takeoff Speed: airspeed at which the main wheels leave the runway.

Tanker Factor: a factor based on tanker gross weight, refueling altitude and refuel speed, used to determine refueling factor.

Touchdown Speed: airspeed at which the main wheels come in contact with the runway

True Airspeed: equivalent airspeed corrected for air density.

Universal Pylon: a built up pylon, trailing edge swept forward from wing to store, designed to carry a single conventional store at the inboard or outboard pylon station, or a multiple ejector rack at the inboard station.

Wind Component (Headwind or Tailwind): that part of the existing wind condition which acts opposite to or in the direction of travel.

CORRECTION CHARTS FOR ALTIMETER AND AIRSPEED INDICATORS

Correction charts for airspeed and altitude (figures A1-1 and A1-2) are provided to determine the values from those indicated on the standby instruments. These curves present the nose boom position error at five altitudes.

STANDBY ALTIMETER POSITION ERROR CORRECTION

Static pressure which determines the altimeter reading is not always accurately measured because of the location of the static port (position error). The altimeter position error chart (figure A1-1) is provided so that corrected pressure altitude can be calculated from the indicator reading.

To determine what indicated altitude to fly so that you will be at your assigned pressure altitude use the following equation:

$$\text{Indicated altitude} = (\text{pressure altitude}) - (\text{Altitude position Error correction})$$

Sample Problem

Given:

- a. Assigned pressure altitude — 20,000 feet
- b. Indicated airspeed (IAS) — 400 Knots

Solution:

- a. Determine Position Error Correction from figure A1-1 = 1010 feet
- b. Indicated Altitude = (Pressure altitude) — (altitude correction)

$$\text{Indicated altitude} = 20,000 \text{ ft} - 1010 \text{ ft}$$

$$\text{Indicated altitude} = 18,990 \text{ ft}$$

Therefore at an indicated airspeed of 400 knots an indicated altitude of 18,990 feet must be maintained on the altimeter to make good an assigned 20,000 feet pressure altitude.

STANDBY AIRSPEED POSITION ERROR CORRECTION

In order to obtain calibrated airspeed a correction for position error must be applied to the indicator reading. This correction is supplied from figure A1-2. When added algebraically to the indicated

airspeed, this correction yields calibrated airspeed (CAS).

Sample Problem

For the purpose of explaining the use of the Airspeed Position Correction Charts consider an aircraft flying at cockpit indicator values of 400 knots at 20,000 feet.

Given:

- a. Assigned Pressure Altitude = 20,000 feet.
- b. Indicated Airspeed = 400 knots.

Solution:

- a. Determine Airspeed Correction from figure A1-2 = 12.5 knots
- b. Calibrated Airspeed = (Indicated Airspeed) + (Airspeed Correction)
- c. Calibrated Airspeed = 400 + 12.5 knots
- d. Calibrated Airspeed = 412.5 KCAS

Therefore at an indicated airspeed of 400 knots and a pressure altitude of 20,000 feet the calibrated airspeed will be 412.5 knots.

When the standby instruments are corrected for their respective errors they will agree, within the system tolerances, with the tape indicated readings corrected for cam error.

IFIS AIRSPEED AND ALTITUDE CORRECTIONS

A mechanical cam in the central air data computer corrects the IFIS airspeed scale and altitude scale for position error. An additional correction for cam error must be applied to obtain true Mach number, calibrated airspeed and pressure altitude.

Sample Problem

Altitude

Given:

- a. Assigned Pressure Altitude = 20,000 feet
- b. Indicated Tape Airspeed = 400 knots

Solution:

- Determine Altitude Correction from figure A1-3 = 150 feet
- Tape altitude Reading = (Pressure Altitude) - (Altitude Correction)
- Tape Altitude Reading = 20,000 - 150 ft
- Tape Altitude Reading = 19,850 feet

To maintain 20,000 feet pressure altitude at an indicated tape airspeed of 400 knots the tape indicated altitude should read 19,850 feet.

Airspeed**Given:**

- Assigned Pressure Altitude = 20,000 ft
- Indicated Tape Airspeed = 400 knots

Solution:

- Determine Airspeed Correction from figure A1-3 = 2 knots
- Calibrated Airspeed = (Indicated Tape Airspeed) + (Airspeed Correction)
- Calibrated Airspeed = 400 + 2 knots
- Calibrated Airspeed = 402 knots

At a pressure altitude of 20,000 feet and indicated tape airspeed of 400 knots the calibrated airspeed is 402 knots.

Mach Number

- Indicated Tape Mach number = 0.85
- Determine Mach Correction from figure A1-3 = 0.006
- True Mach = (Indicated Tape Mach) + (Mach Correction)
- True Mach = 0.85 + 0.006 Mach
- True Mach = 0.856 Mach

STORE DRAG NUMBER AND AIRCRAFT CONFIGURATION DRAG INDEX

Store Drag Number and Gross Weight Table Figure A1-5 presents a partial listing of required external stores. A drag number has been assigned to each store for each aircraft position at which the store can be carried. Store drag numbers are given for single carriage of weapons and multiple carriage on MER where applicable. The drag index for a given configuration is the sum of the store drag numbers. Incremental weights for each external store are also shown on this table for use in determining the total aircraft weight.

EXAMPLE [947] N/C/W

Determine the configuration drag index for the following configuration: Six (6) M117 750 lb bombs on the centerline MER plus two (2) 450 gallon wing tanks plus two (2) M117 750 lb bombs on the outboard pylons.

From figure A1-5.

Two (2) 450 gallon tanks at inboard station.

Read for one (1) 450 gallon tank at inboard location a drag number of 14. The drag number for two (2) 450 gallon tanks is $2 \times 14 = 28$.

Read for one (1) M117 750 lb bomb at the outboard station in the presence of inboard station fuel tanks a drag number of 16. The drag number for two (2) M117 750 lb bombs at the outboard stations in the presence of inboard fuel tanks is $2 \times 16 = 32$.

Read for six (6) M117 750 lb bombs on centerline location a drag number of 75. As noted this drag number includes the MER required for carriage of six (6) M117 lb bombs on the centerline station.

The configuration drag index is the sum of the store drag numbers $28 + 32 + 75 = 135$.

DRAG NUMBERS FOR ASYMMETRICAL WEIGHT TRIM DRAG

For configurations consisting of stores that result in a weight asymmetry an additional drag number must be determined for the additional drag due to the deflection of control surfaces required for trim. Figure A1-6 presents a chart from which this additional drag number may be determined for any given flight condition.

EXAMPLE

Determine the additional drag number for a weight asymmetry of 2000 lb for the following flight conditions: 30,000 feet pressure altitude at $M = 0.9$ Aircraft Gross Weight of 44,000 lb.

Enter figure A1-6 at (A) Net Weight Asymmetry of 2000 lb; move to (B) pressure altitude of 30,000 ft; move up to (C) Mach Number 0.9, proceed across to (D) aircraft Gross Weight of 44,000 lb; then down to (E) Mach Number of 0.9 and across to (F) and read an Incremental Drag Number of 20. This incremental drag number is added to the sum of the Store Drag Numbers to determine the total Configuration Drag Index.

AIRSPEED, MACH NUMBER CONVERSION CHARTS

These charts show the relationship between calibrated airspeed, true airspeed and Mach number under any ambient conditions. The first chart covers speeds between 100 and 800 KCAS and Mach numbers from 0.3 through 1.2 The second chart goes up to 2.0 Mach number and 1000 KCAS. The use of

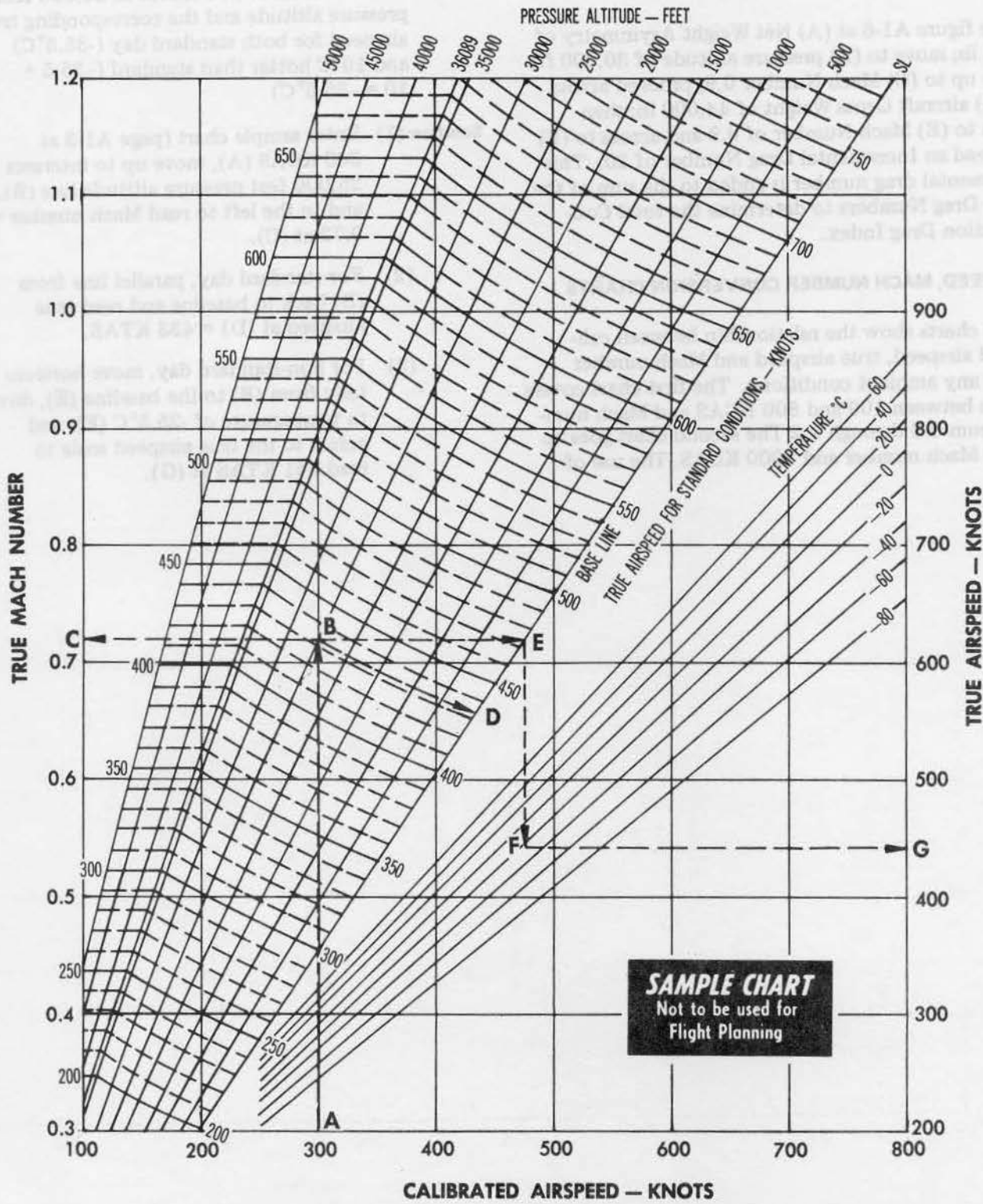
the conversion charts is illustrated in the following sample problem.

Find: Mach number at 300 KCAS at 25,000 feet pressure altitude and the corresponding true airspeed for both standard day (-35.5°C) and 10°C hotter than standard ($-35.5 + 10 = -25.5^{\circ}\text{C}$)

- Solution:**(1) Enter sample chart (page A1-3 at 300 KCAS (A), move up to intersect 25,000 feet pressure altitude line (B), and to the left to read Mach number = 0.72 at (C).
- (2) For standard day, parallel line from (B) back to baseline and read true airspeed at (D) = 433 KTAS.
- (3) For non-standard day, move horizontally from (B) to the baseline (E), down to temperature of -25.5°C (F), and across to the true airspeed scale to read 441 KTAS at (G).



AIRSPED — MACH NUMBER CONVERSION CHART



**STANDBY ALTIMETER
POSITION ERROR CORRECTION
(NOSE BOOM)**

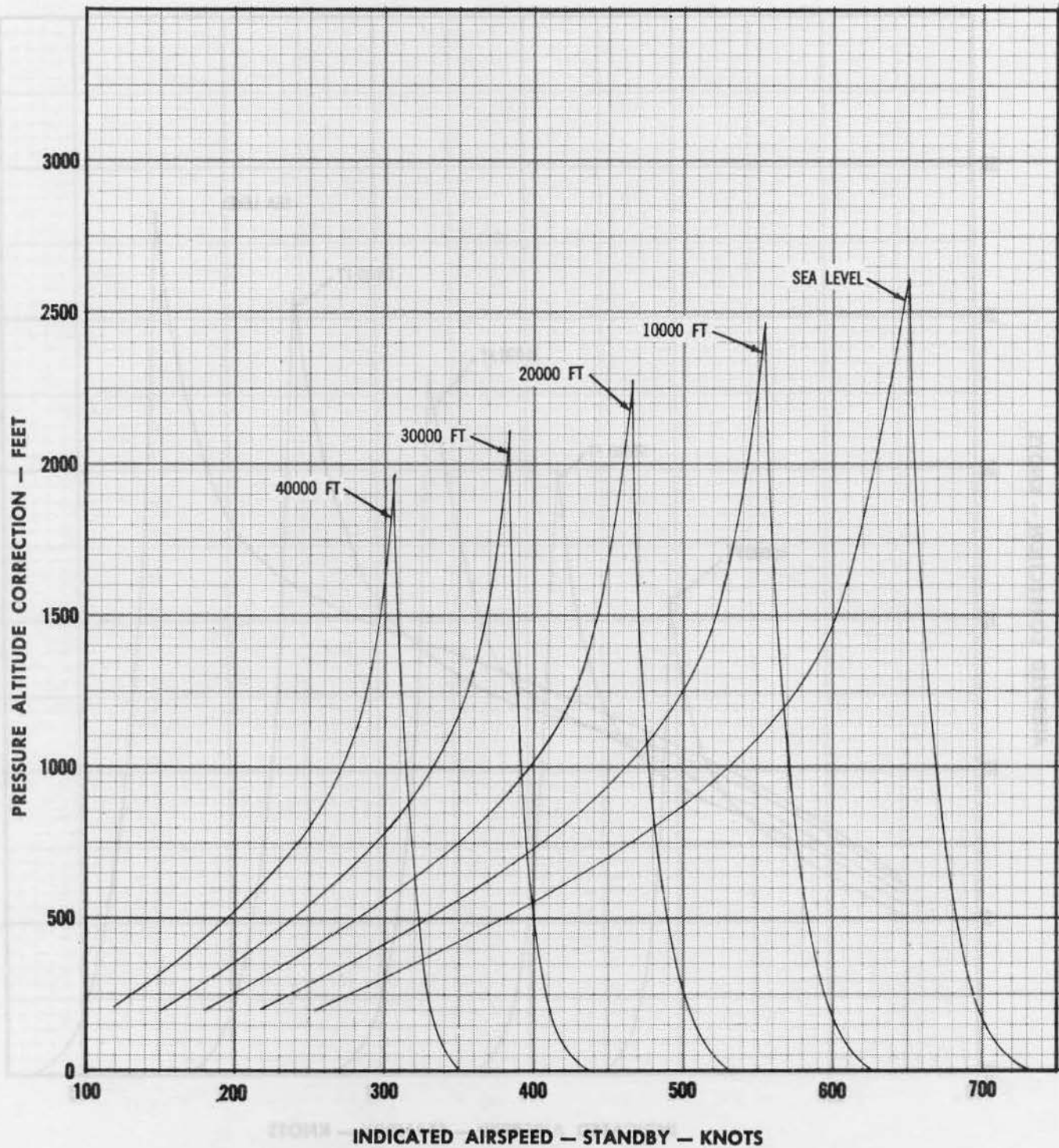


Figure A1-1

NOTE

These curves are intended to be used
ONLY for aircraft in flight attitude,
NOT during ground roll.



**STANDBY AIRSPEED INDICATOR
POSITION ERROR CORRECTION
(NOSE BOOM)**

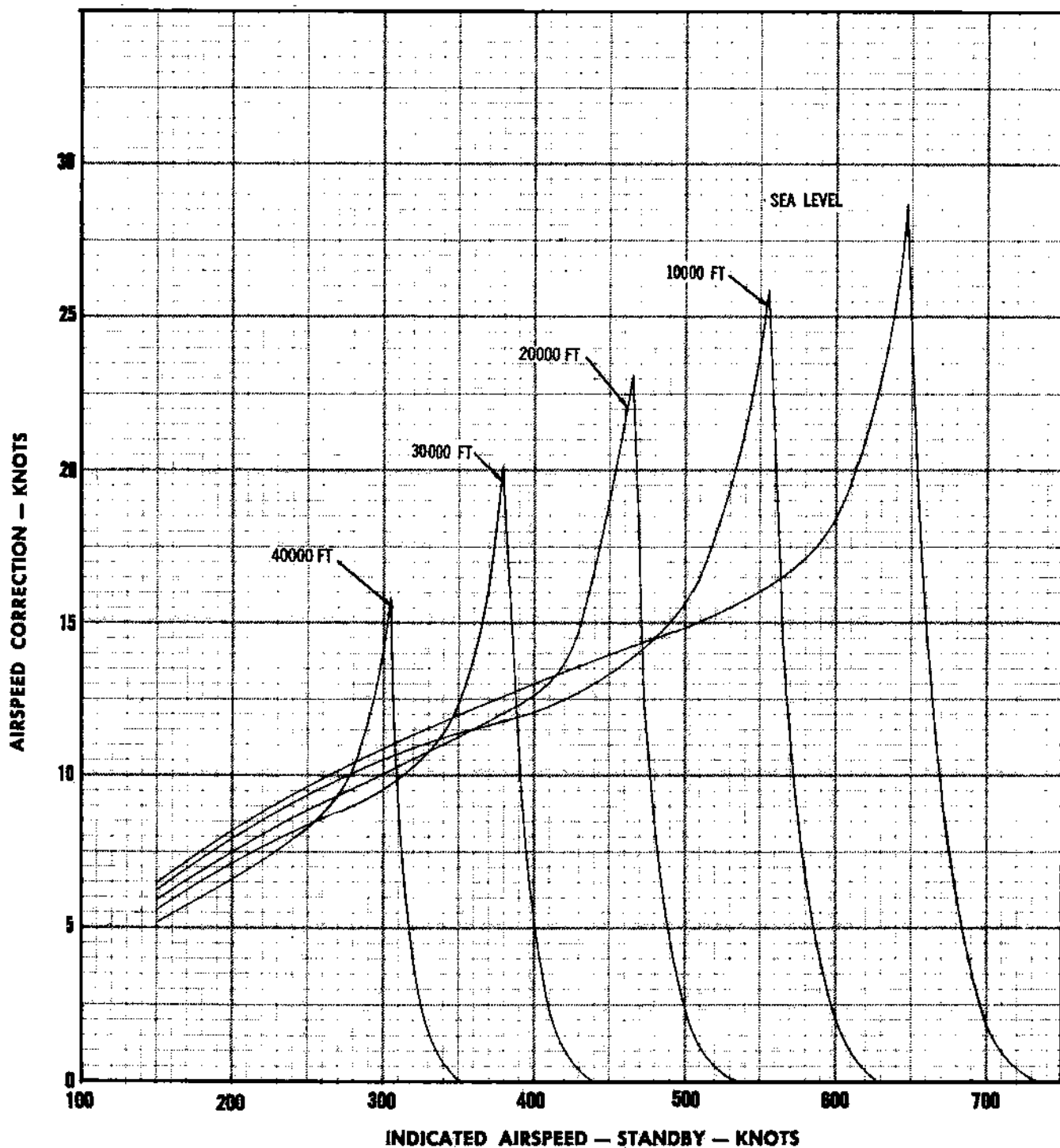


Figure A1-2

CORRECTIONS TO AMI AND AVVI READINGS AT TRUE PRESSURE ALTITUDE

D

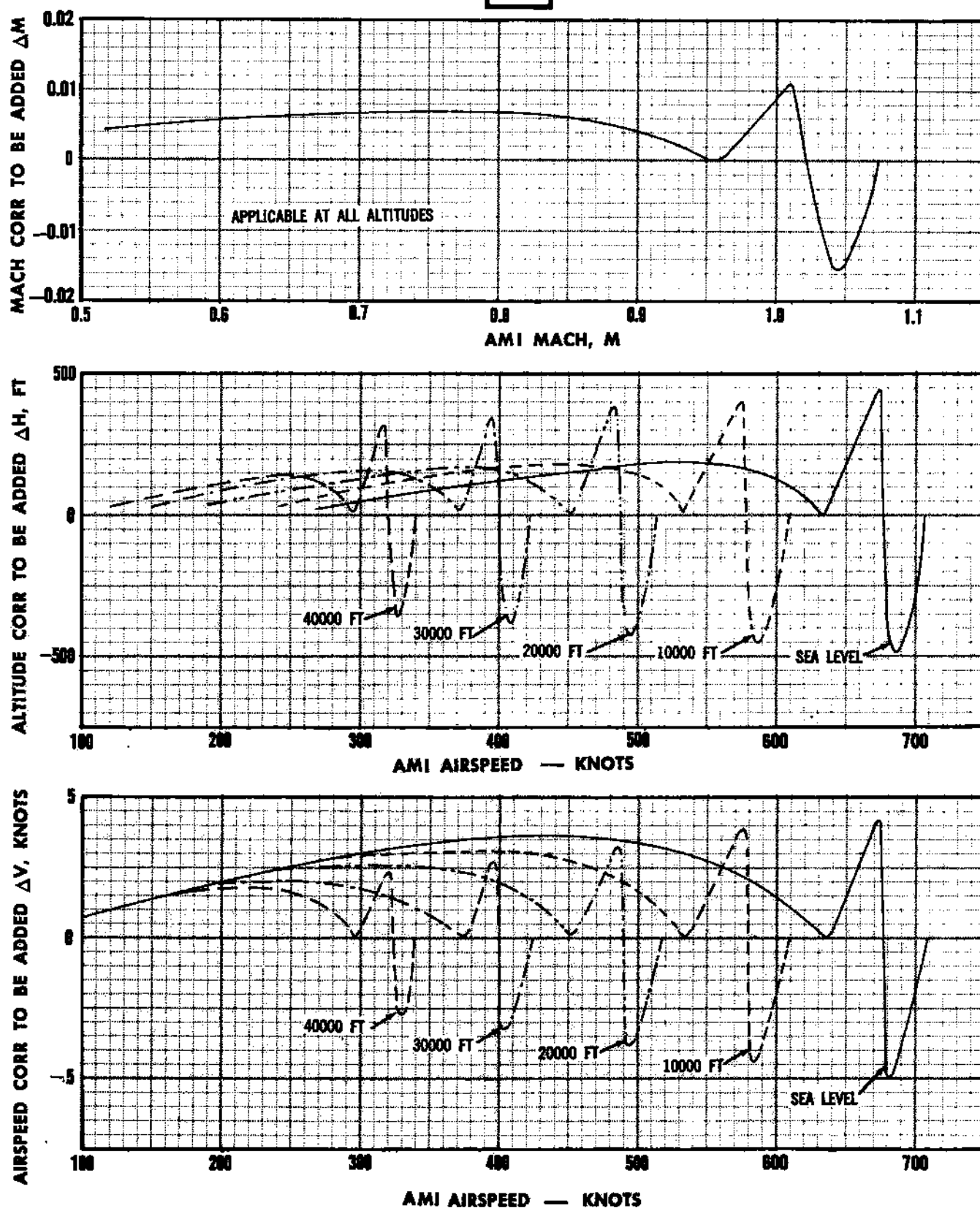
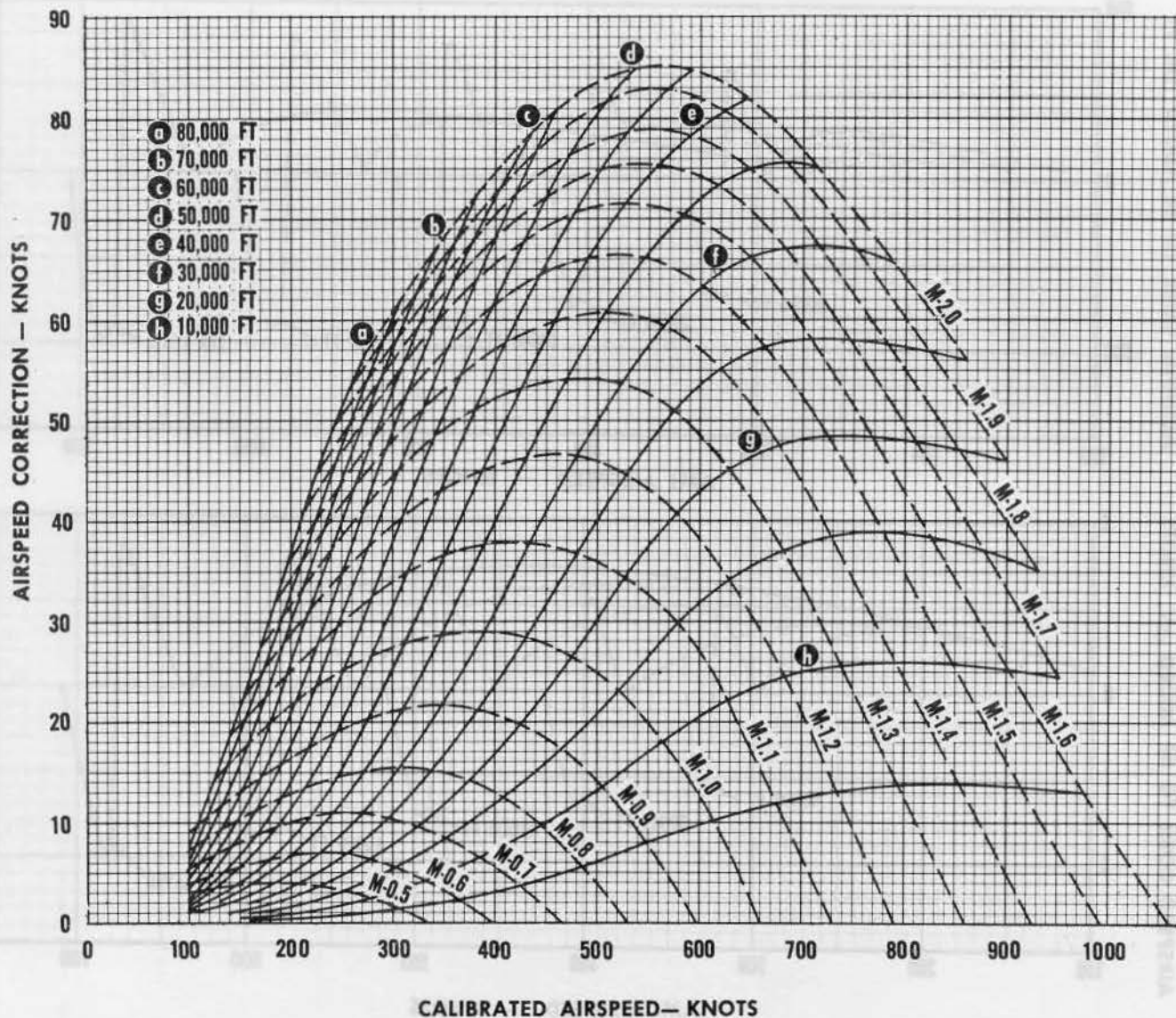


Figure A1-3

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

NOTE: Subtract correction from calibrated airspeed to obtain equivalent airspeed.



AVERAGE AIRCRAFT GROSS WEIGHTS AND DRAG NUMBERS



Clean without B/B tank, 7540
pounds of internal fuel. (Usable fuel)
Gross Wt. lb.

Drag
Number

Aircraft	35705	20
B/B tank install (2535 lb. fuel)	150(2685)Ⓢ	—
Camouflage Paint	150	8
Wild Weasel I [982, D-683, D-683C] C/W	148	4
Documentation Camera [D-682] C/W	46	10.5

STORE DRAG NUMBERS AND GROSS WEIGHTS

STORE	GROSS WEIGHT LB.	LOCATION			
		Centerline	Inboard	Outboard	
				Inboard Clean	Inbd with store (Inbd Drag No. not included)
All Store Drag Nos. include necessary suspension equip.	(Store Only)				
INTEGRAL PYLON FUEL TANKS					
(1) 650 Gallon (4225 lbs fuel)	Ⓐ 347(4572)Ⓢ	24			
(1) 450 Gallon (2925 lbs fuel)	Ⓐ 267(3192)Ⓢ Ⓑ 330(3255)Ⓢ	15	14		
SINGLE WEAPONS					
(1) M-117D Destructor	880			17	19
(1) M-117R 750 Lb. Retarded Bomb	880			17	19
(1) M-117 750 Lb. Bomb	823		14	13	16
(1) M-117 w/M1A1 fuze ext	823		14	13	16
(1) M-118 (T-55) Bomb	3049	17	19		
(1) MC-1 Chemical Bomb	725		14	13	16
(1) M-129 (T-58) Leaflet Bomb	200		14	13	16
(1) LAU-3 /A Rocket Launcher	427		11	10	13
(1) LAU-18 /A Rocket Launcher	450		11	10	13
(1) LAU-32A /A Rocket Launcher	47(173)Ⓢ		11	10	11
(1) LAU-59 /A Rocket Launcher	48(173)Ⓢ		13	12	13
(1) SUU-21/A Practice Bomb Disp.	470(622)Ⓢ	12	18		
(6) MLU-32/B-99 Briteye Flare	900	40			
(1) BLU-1 /B Firebomb	697		14	13	16
(1) BLU-27 /B Firebomb (Finned)	870		15	14	17
(1) BLU-27 /B Firebomb (Unfinned)	857		14	13	16
(1) BLU-52 /B Chemical Bomb	370	15	15	14	17
(1) M116A Firebomb	720		14	13	16
(1) CBU-1 /A (Dispenser)	(752)Ⓢ			11	18
(1) CBU-1A /A (Dispenser)	(752)Ⓢ			11	18
(1) CBU-2 /A (Dispenser)	(749)Ⓢ			11	18
(1) CBU-2A /A (Dispenser)	(828)Ⓢ			11	18
(1) CBU-2B /A (Dispenser)	(840)Ⓢ			11	18
(1) CBU-2C /A (Dispenser)	(877)Ⓢ			11	18
(1) CBU-3 /A (Dispenser)	(658)Ⓢ			11	18
(1) CBU-3A /A (Dispenser)	(653)Ⓢ			11	18

Figure A1-5 (Sheet 1 of 5)

D**STORE DRAG NUMBERS AND GROSS WEIGHTS (Cont)**

STORE	GROSS WEIGHT LB.	LOCATION			
		Centerline	Inboard	Outboard	
All Store Drag Nos. include necessary suspension equip.	(Store Only)			Inboard Clean	Inbd with store (Inbd Drag No. not included)
(1) SUU-20/A (empty)	245	22	24	24	37
(1) SUU-20/A(M) or SUU-20A/A (empty)	335	22	24	24	37
(1) SUU-20/A (4 FFAR)	315			24	37
(1) SUU-20/A(M) or SUU-20A/A (4 FFAR)	405			24	37
(1) SUU-20/A (4 FFAR, (6) 25 lb class bombs)	450		28		
(1) SUU-20/A (4 FFAR, (6) MK-106 practice bombs)	345		37		
(1) SUU-20/A(M) or SUU-20A/A (4 FFAR, (6) 25 lb class bombs)	540		28		
(1) SUU-20/A(M) or SUU-20A/A (4 FFAR, (6) MK-106 practice bombs)	435		37		
(1) SUU-20/A ((6) 25 lb class bombs)	375	26			
(1) SUU-20/A ((6) MK-106 practice bombs)	275	36			
(1) SUU-20/A(M) or SUU-20A/A ((6) 25 lb class bombs)	465	26			
(1) SUU-20/A(M) or SUU-20A/A ((6) MK-106 practice bombs)	365	36			

Figure A1-5 (Sheet 1A of 5)

D**STORE DRAG NUMBERS AND GROSS WEIGHTS (Cont)**

STORE	GROSS WEIGHT LB.	LOCATION			
		Centerline	Inboard	Outboard	
All Store Drag Nos. include necessary suspension equip.	(Store Only)			Inboard Clean	Inbd with store (Inbd Drag No. not included)
(1) CBU-7 A (SUU-13 A Dispenser) with BLU-18/B Bomblets.	190(820)ⓐ	10		12	13
(1) CBU-24 B (Dispenser)	(830)ⓐ		14	13	16
(1) CBU-24A/B (Dispenser)	(830)ⓐ			13	16
(1) CBU-24B/B (Dispenser)	(832)ⓐ			13	16
(1) CBU-28 A (Dispenser)	188(461)ⓐ	10		12	13
(1) CBU-29 B (Dispenser)	(830)ⓐ		14	13	16
(1) CBU-29A/B (Dispenser)	(830)ⓐ			13	16
(1) CBU-29B/B (Dispenser)	(832)ⓐ			13	16
(1) CBU-30 A (Dispenser)	190(385)ⓐ	10		12	13
(1) CBU-37 A (Dispenser)	188 (461) ⓐ		14	13	16
(1) CBU-49/B (Dispenser)	(830)ⓐ		14	13	16
(1) CBU-49A/B (Dispenser)	(830)ⓐ			13	16
(1) CBU-46 A (Dispenser)	(877)ⓐ			13	16
(1) CBU-49B/B (Dispenser)				13	16
(1) CBU-53 B (Dispenser)	(832)ⓐ			13	16
(1) CBU-54 B (Dispenser)	(832)ⓐ			13	16
(1) MK-82 (Snakeye)	560		15	14	14
(1) MK-82 (Bomb)	531		11	10	11
(1) MK-82 w/M1A1 fuze ext			11	10	11
(1) MK-83 (Bomb)	985		12	11	14
(1) MK-84 (Bomb)	1970	13	15		
(1) MA-2 Rocket Launcher	25(65)ⓐ		9	8	8
(1) AGM-12B (Missile)	567-593ⓐ		10	10	13
(1) AGM-12C (Missile)	1779		18		
(1) AGM-45A (Shrike)	392			6	8
(1) AGM-78A (Missile)	1354		25		
(1) QRC-160-1 Pod	200			5	8
(1) QRC-160-2 Pod	185			5	8
(1) QRC-160-8 Pod	300			5	8
(1) QRC-335A with RATG	317			5	8
(1) QRC-335A without RATG	242			5	8
(1) A B-45Y-2 Spray Tank	488 (793) TX Agentⓐ (561) LX Agentⓐ			12	30
(1) AN ALE-2 Chaff Dispenser	205(425)ⓐ			11	26
(1) BDU-4/B or Parent Weapon	—	15	17		
(1) MD-6 or Parent Weapon	—	15	17		
(1) BDU-8-B (Long or short nose) With drag ring	—	22	29		
No drag ring		17	19		

NOTES:

- ⓐ Integral Tank and Pylon, Centerline
 ⓑ Integral Tank and Pylon, Wing Inboard

- ⓓ Range of Weight depending on type AGM-12B
 ⓔ Empty (Maximum Full)

Figure A1-5 (Sheet 2 of 5)



STORE DRAG NUMBERS AND GROSS WEIGHTS (Cont)

STORE	GROSS WEIGHT LB.	LOCATION			
		Centerline	Inboard	Outboard	
All Store Drag Nos. include necessary suspension equip.	(Store Only)			Inboard Clean	Inbd with store (Inbd Drag No. not included)
MULTIPLE WEAPONS					
(3) M-117D Destructor	2640	67			
(3) M-117 750 Lb. Retarded Bomb	2640	67			
(6) M-117 750 Lb. Bombs	4938	75			
(4) M-117 750 Lb. Bombs	3292	52	40		
(6) M-117 w/M1A1 fuze ext	4938	75			
(6) MC-1 Chemical Bombs	4350	75			
(4) MC-1 Chemical Bombs	2900	52	40		
(6) M-129 (T-58) Bombs	1200	75			
(4) M-129 (T-58) Bombs	800	52	40		
(2) LAU-3 A Rocket Launchers	854		38		
(2) LAU-18 A Rocket Launchers	900		38		
(2) LAU-32A A Rocket Launchers	346		25		
(2) LAU-59 A Rocket Launchers	346		28		
(3) BLU-1 B Firebombs	2091	42			
(2) BLU-1 B Firebombs	1394	23	27		
(2) BLU-27 B Firebomb (Finned)	1740	25	29		
(2) BLU-27 B Firebomb (Unfined)	1714	23	27		
(2) BLU-52 B Chemical Bomb	740	25	27		
(3) M116A Firebombs	2160	42			
(2) M116A Firebombs	1440	23	27		
(5) CBU-24 B Dispenser	4150	68			
(4) CBU-24 B Dispenser	3320	52			
(5) CBU-24A B Dispenser	4150	68			
(4) CBU-24A B Dispenser	3320	52			
(5) CBU-24B B Dispenser	4160	68			
(4) CBU-24B B Dispenser	3328	52			
(5) CBU-29 B	4150	68			
(4) CBU-29 B Dispenser	3320	52			
(5) CBU-29A B Dispenser	4150	68			
(4) CBU-29A B Dispenser	3320	52			
(5) CBU-29B B Dispenser	4160	68			
(4) CBU-29B B Dispenser	3328	52			
(5) CBU-49 B Dispenser	4150	68			
(4) CBU-49 B Dispenser	3320	52			
(5) CBU-49A B Dispenser	4150	68			
(4) CBU-49A B Dispenser	3320	52			
(5) CBU-49B B Dispenser	4160	68			
(4) CBU-49B B Dispenser	3328	52			
(5) CBU-53 B Dispenser	4160	68			
(4) CBU-53 B Dispenser	3328	52			
(5) CBU-54 B Dispenser	4160	68			
(4) CBU-54 B Dispenser	3328	52			

Figure A1-5 (Sheet 3 of 5)

**STORE DRAG NUMBERS AND GROSS WEIGHTS (Cont)**

STORE	GROSS WEIGHT LB.	LOCATION			
		Centerline	Inboard	Outboard	
				Inboard Clean	Inbd with store (Inbd Drag No. not included)
All Store Drag Nos. include necessary suspension equip.	(Store Only)				
(6) MK-82 (Snakeye)	3360	57			
(4) MK-82 (Snakeye)	2240	41	39		
(3) MK-82 (Snakeye)	1680	44			
(2) MK-82 (Snakeye)	1120		31		
(6) MK-82 (Bomb)	3186	45			
(4) MK-82 (Bomb)	2124	33	31		
(4) MK-82 w/M1A1 fuze ext		33	31		
(3) MK-83 (Bomb)	2955	31			
(2) MK-83 (Bomb)	1970	17	23		
(2) AIM-9B Sidewinders	310			13	24
(2) AIM-9E Sidewinders	310			13	24
(1) BLU-31/B	800			28	33
(2) BLU-31/B	1600		44		
(3) BLU-31/B	2400	47			

Figure A1-5 (Sheet 4 of 5)

D

STORE DRAG NUMBERS
Pylons or Racks Only — No Ordnance

PYLONS	CENTERLINE	INBOARD	OUTBOARD
(1) Multi-Weapon or Universal Pylon with Multi Ejector Rack	13	14	—
(1) Centerline MER Pylon with Multi Ejector Rack	15	—	—
(1) Multi-Weapon or Universal Pylon only	3	6	4
(1) Special Pylon for AGM-12B	—	3	2
(1) Special Pylon, Adapter and Launcher for (2) AIM-9B	—	—	3
(1) Launcher Adapter on Inboard AGM-78 Pylon (modified MWP)	—	7	—

STORE WEIGHTS (LB)
Pylons or Racks Only — No Ordnance

PYLONS AND RACKS	CENTERLINE	INBOARD	OUTBOARD
(1) Universal Pylon, 14" Rack ®	—	202	132
(1) Universal Pylon, 30" Rack ®	—	239	—
(1) Multiple Weapon Pylon	342	245	—
(1) Centerline MER Pylon	126	—	—
(1) Special Pylon for AGM-12B with Adapter	—	147	131
(1) Special Pylon for (2) AIM-9B with Adapter & Launcher	—	—	151
(1) Multiple Ejector Rack On Multi-Weapon or Universal Pylon (4 position)	172	172	—
On Centerline MER Pylon (6 position)	198	—	—
(1) AGM-78 Pylon (modified MWP) plus Launcher	—	432	—

® For Direct Loaded Conventional Weapons Only

STORE DRAG NUMBERS AND GROSS WEIGHTS
A/A 37U-15 EXTERNAL TOW TARGET SYSTEM

TARGET POSITION	GROSS WEIGHT LB	STORE DRAG NO.
Captive K-11	1206	90
TDU-10/B	1199	90
Towed K-11	1206	100
TDU-10/B	1199	100
Released	829	33

Figure A1-5 (Sheet 5 of 5)

D

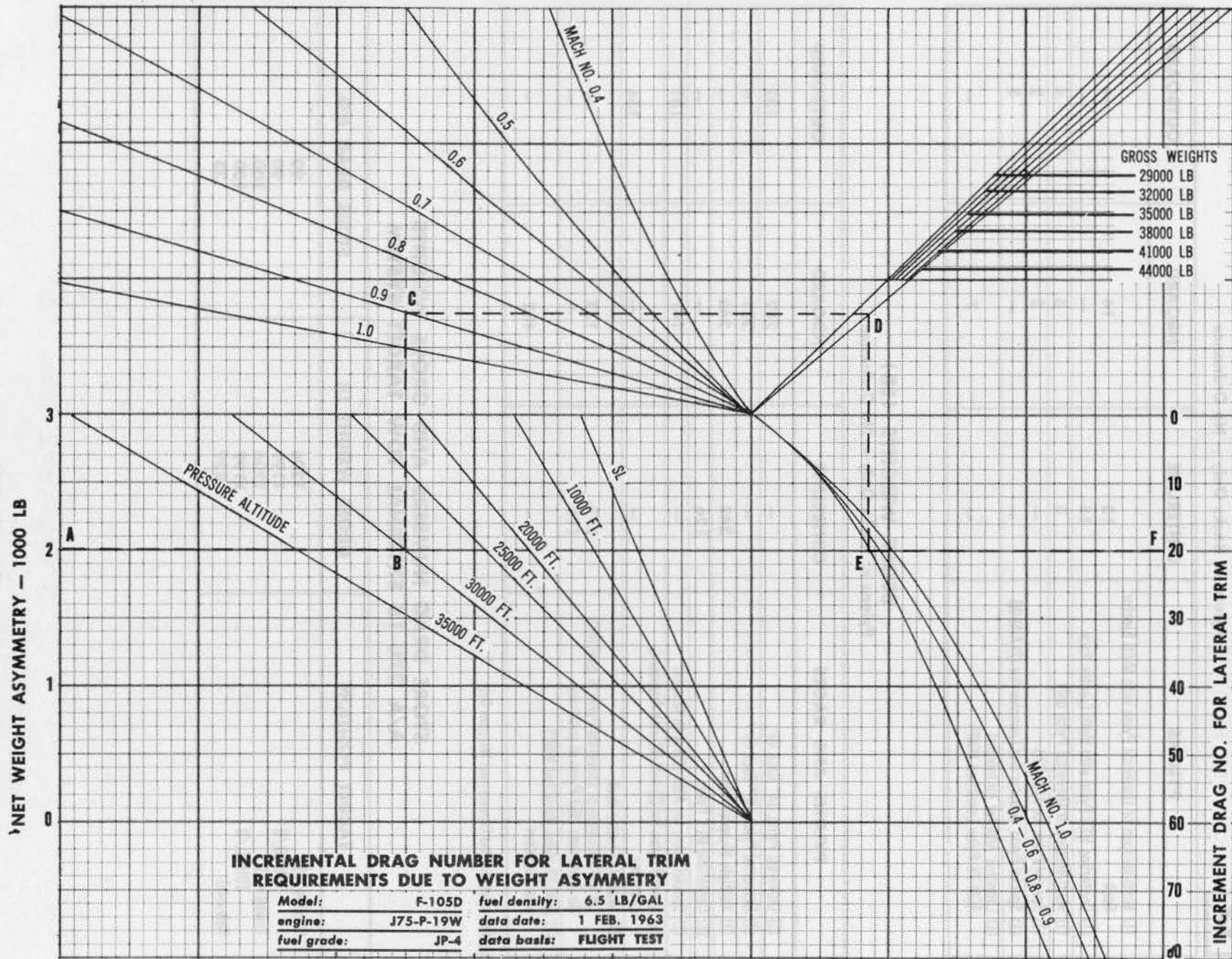


Figure A1-6

AIRSPEED — MACH NUMBER CONVERSION CHART

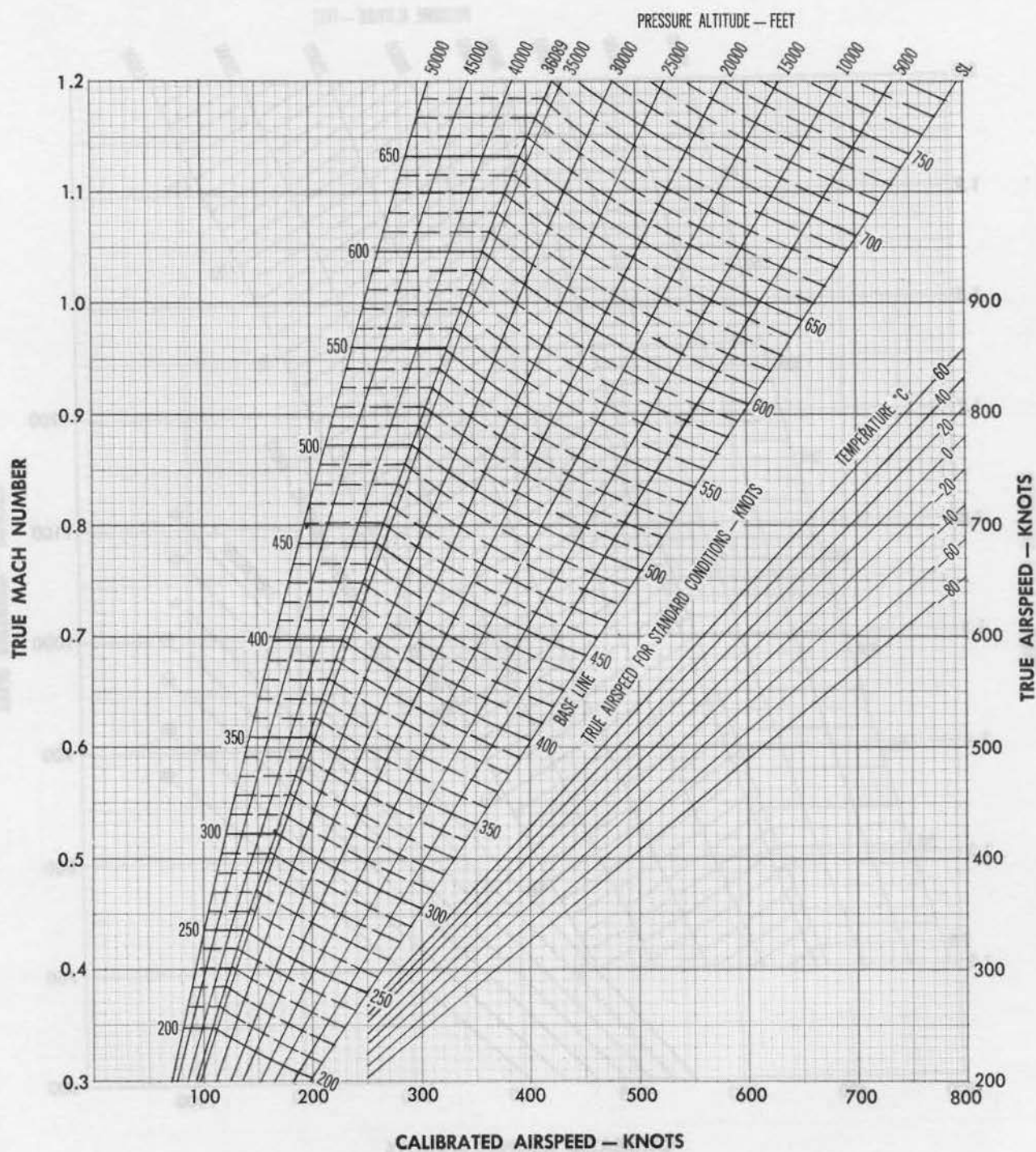


Figure A1-7 (Sheet 1 of 2)



AIRSPEED — MACH NUMBER CONVERSION CHART

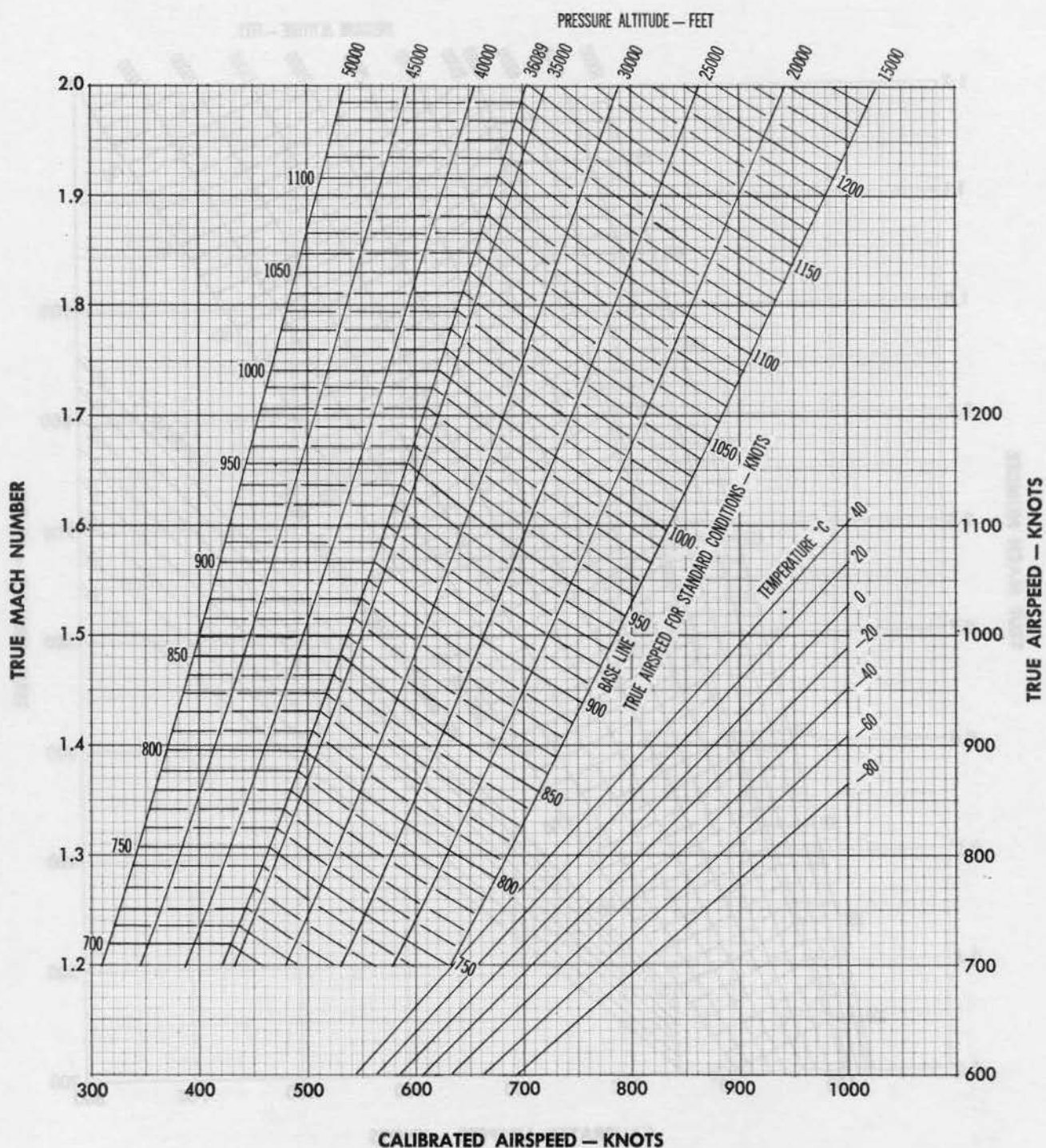


Figure A1-7 (Sheet 2 of 2)

TEMPERATURE CORRECTION FOR COMPRESSIBILITY

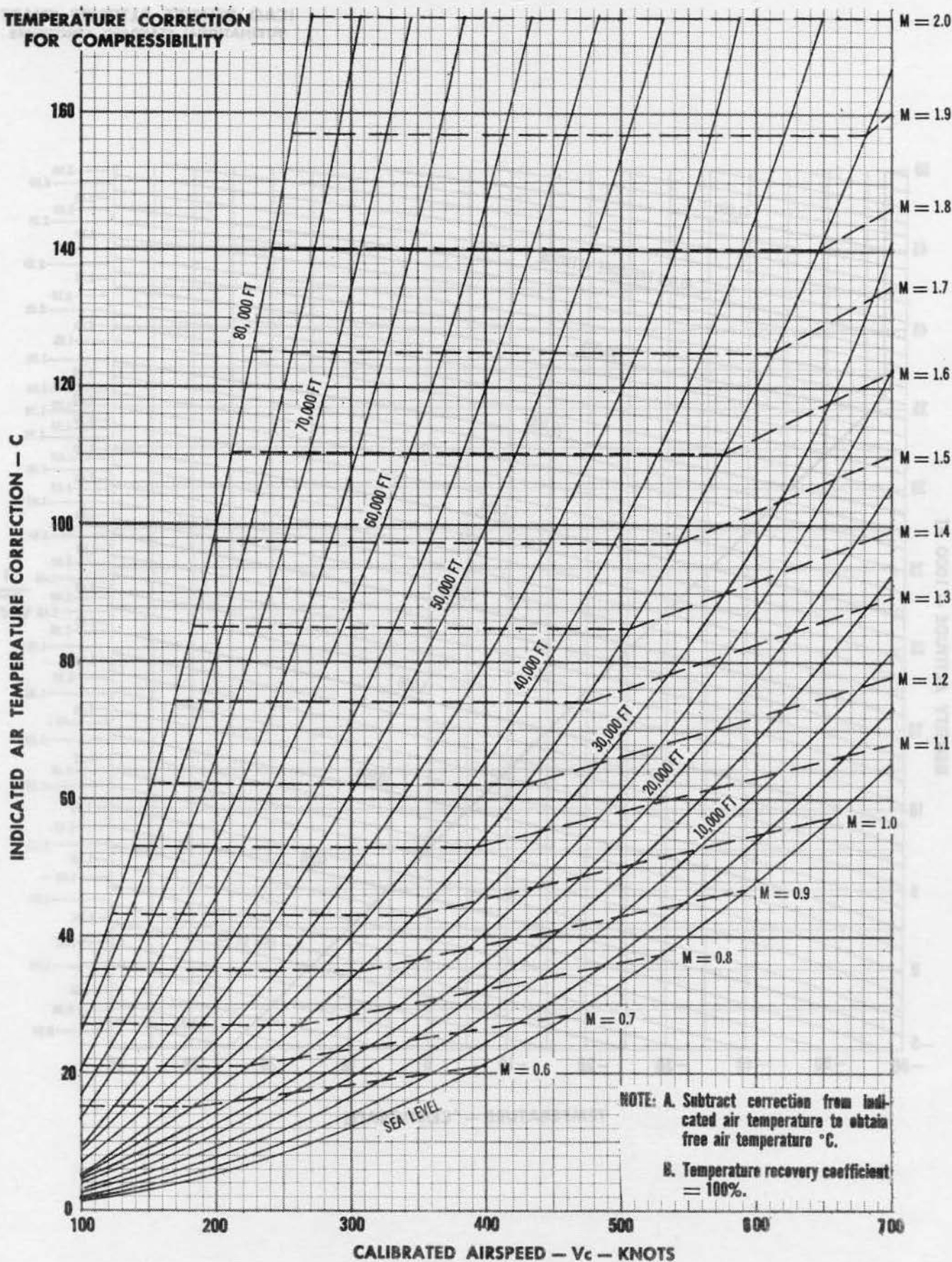


Figure A1-8

ICAO DENSITY ALTITUDE CHART

INTERNATIONAL STANDARD ATMOSPHERE

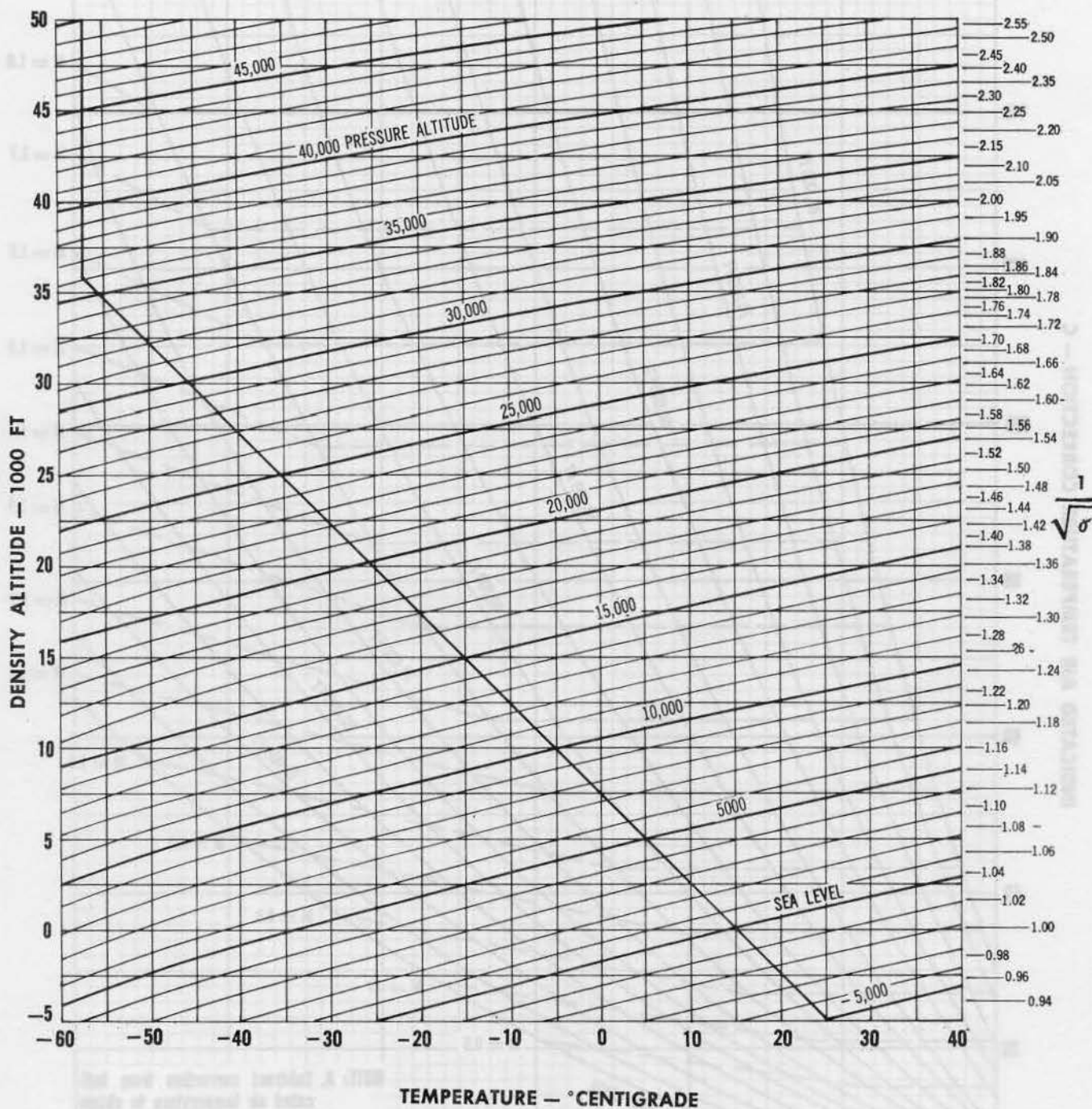


Figure A1-9

STANDARD ATMOSPHERE
table

STANDARD ATMOSPHERE

table

(ICAO)

Standard SL Conditions

TEMPERATURE 15°C (59°F)
PRESSURE 29.921 IN. Hg 2116.216 LB/SQ FT
DENSITY .0023769 SLUGS/CU FT
SPEED OF SOUND 1116.89 FT/SEC 661.7 KNOTS

Conversion Factors

1 IN. Hg 70.727 LB/SQ FT
1 IN. Hg 0.49116 LB/SQ IN.
1 KNOT 1.151 MPH
1 KNOT 1.688 FT/SEC

ALTITUDE FEET	DENSITY RATIO σ	$\sigma - 1/2$ $\frac{1}{\sqrt{\sigma}}$	TEMPERATURE		SPEED OF SOUND KNOTS	PRESSURE IN. Hg	PRESSURE RATIO δ
			°C	°F			
0	1.000	1.0000	15.000	59.000	661.7	29.921	1.0000
1000	.9711	1.0148	13.019	55.434	659.5	28.856	.9644
2000	.9428	1.0299	11.038	51.868	657.2	27.821	.9298
3000	.9151	1.0454	9.056	48.302	654.9	26.817	.8962
4000	.8881	1.0611	7.076	44.735	652.6	25.842	.8637
5000	.8617	1.0773	5.094	41.169	650.3	24.896	.8320
6000	.8359	1.0938	3.113	37.603	648.7	23.978	.8014
7000	.8106	1.1107	1.132	34.037	645.6	23.088	.7716
8000	.7860	1.1279	-0.850	30.471	643.3	22.225	.7428
9000	.7620	1.1456	-2.831	26.905	640.9	21.388	.7148
10,000	.7385	1.1637	-4.812	23.338	638.6	20.577	.6877
11,000	.7155	1.1822	-6.793	19.772	636.2	19.791	.6614
12,000	.6932	1.2011	-8.774	16.206	633.9	19.029	.6360
13,000	.6713	1.2205	-10.756	12.640	631.5	18.292	.6113
14,000	.6500	1.2403	-12.737	9.074	629.0	17.577	.5875
15,000	.6292	1.2606	-14.718	5.508	626.6	16.886	.5643
16,000	.6090	1.2815	-16.699	1.941	624.2	16.216	.5420
17,000	.5892	1.3028	-18.680	-1.625	621.8	15.569	.5203
18,000	.5699	1.3246	-20.662	-5.191	619.4	14.942	.4994
19,000	.5511	1.3470	-22.643	-8.757	617.0	14.336	.4791
20,000	.5328	1.3700	-24.624	-12.323	614.6	13.750	.4595
21,000	.5150	1.3935	-26.605	-15.889	612.1	13.184	.4406
22,000	.4976	1.4176	-28.587	-19.456	609.6	12.636	.4223
23,000	.4806	1.4424	-30.568	-23.022	607.1	12.107	.4046
24,000	.4642	1.4678	-32.549	-26.588	604.6	11.597	.3876
25,000	.4481	1.4938	-34.530	-30.154	602.1	11.103	.3711
26,000	.4325	1.5206	-36.511	-33.720	599.6	10.627	.3552
27,000	.4173	1.5480	-38.492	-37.286	597.1	10.168	.3398
28,000	.4025	1.5762	-40.474	-40.852	594.6	9.725	.3250
29,000	.3881	1.6052	-42.455	-44.419	592.1	9.297	.3107
30,000	.3741	1.6349	-44.436	-47.985	589.5	8.885	.2970

Figure A1-10 (Sheet 1 of 2)

STANDARD ATMOSPHERE
table

ALTITUDE FEET	DENSITY RATIO σ	$\sigma - 1/2$ $\frac{1}{\sqrt{\sigma}}$	TEMPERATURE		SPEED OF SOUND KNOTS	PRESSURE IN. Hg	PRESSURE RATIO δ
			°C	°F			
31,000	.3605	1.6654	-46.417	-51.551	586.9	8.488	.2837
32,000	.3473	1.6968	-48.398	-55.117	584.4	8.106	.2709
33,000	.3345	1.7291	-50.379	-58.683	581.8	7.737	.2586
34,000	.3220	1.7623	-52.361	-62.249	579.2	7.382	.2467
35,000	.3099	1.7964	-54.342	-65.816	576.6	7.041	.2353
36,000	.2981	1.8315	-56.323	-69.382	574.0	6.712	.2243
36,089	.2971	1.8347	-56.500	-69.700	573.7	6.683	.2234
37,000	.2843	1.8753				6.397	.2138
38,000	.2710	1.9209				6.097	.2038
39,000	.2583	1.9677				5.811	.1942
40,000	.2462	2.0155				5.538	.1851
41,000	.2346	2.0645	-56.500	-69.700	573.7	5.278	.1764
42,000	.2236	2.1148				5.030	.1681
43,000	.2131	2.1662				4.794	.1602
44,000	.2031	2.2189				4.569	.1527
45,000	.1936	2.2728				4.355	.1455
46,000	.1845	2.3281				4.151	.1387
47,000	.1758	2.3848				3.956	.1322
48,000	.1676	2.4428				3.770	.1260
49,000	.1597	2.5022				3.593	.1201
50,000	.1522	2.5630				3.425	.1145
51,000	.1451	2.6254				3.264	.1091
52,000	.1383	2.6892				3.111	.1040
53,000	.1318	2.7546				2.965	.09909
54,000	.1256	2.8216				2.826	.09444
55,000	.1197	2.8903				2.693	.09001
56,000	.1141	2.9606				2.567	.08578
57,000	.1087	3.0326				2.446	.08176
58,000	.1036	3.1063				2.331	.07792
59,000	.09877	3.1819				2.222	.07426
60,000	.09414	3.2593				2.118	.07078
61,000	.08972	3.3386	-56.500	-69.700	573.7	2.018	.06746
62,000	.08551	3.4198				1.924	.06429
63,000	.08150	3.5029				1.833	.06127
64,000	.07767	3.5881				1.747	.05840
65,000	.07403	3.6754				1.665	.05566
66,000	.07055	3.7649				1.587	.05305
67,000	.06724	3.8564				1.513	.05056
68,000	.06409	3.9502				1.442	.04819
69,000	.06108	4.0463				1.374	.04592
70,000	.05821	4.1447				1.310	.04377
71,000	.05548	4.2456				1.248	.04171
72,000	.05288	4.3488				1.190	.03976
73,000	.05040	4.4545				1.134	.03789
74,000	.04803	4.5633				1.081	.03611
75,000	.04578	4.6738				1.030	.03442
76,000	.04363	4.7874				0.982	.03280
77,000	.04158	4.9039				0.935	.03126
78,000	.03963	5.0231				0.892	.02980
79,000	.03777	5.1454				0.850	.02840
80,000	.03600	5.2706				0.810	.02707

Figure A1-10 (Sheet 2 of 2)

TEMPERATURE CONVERSION CHART

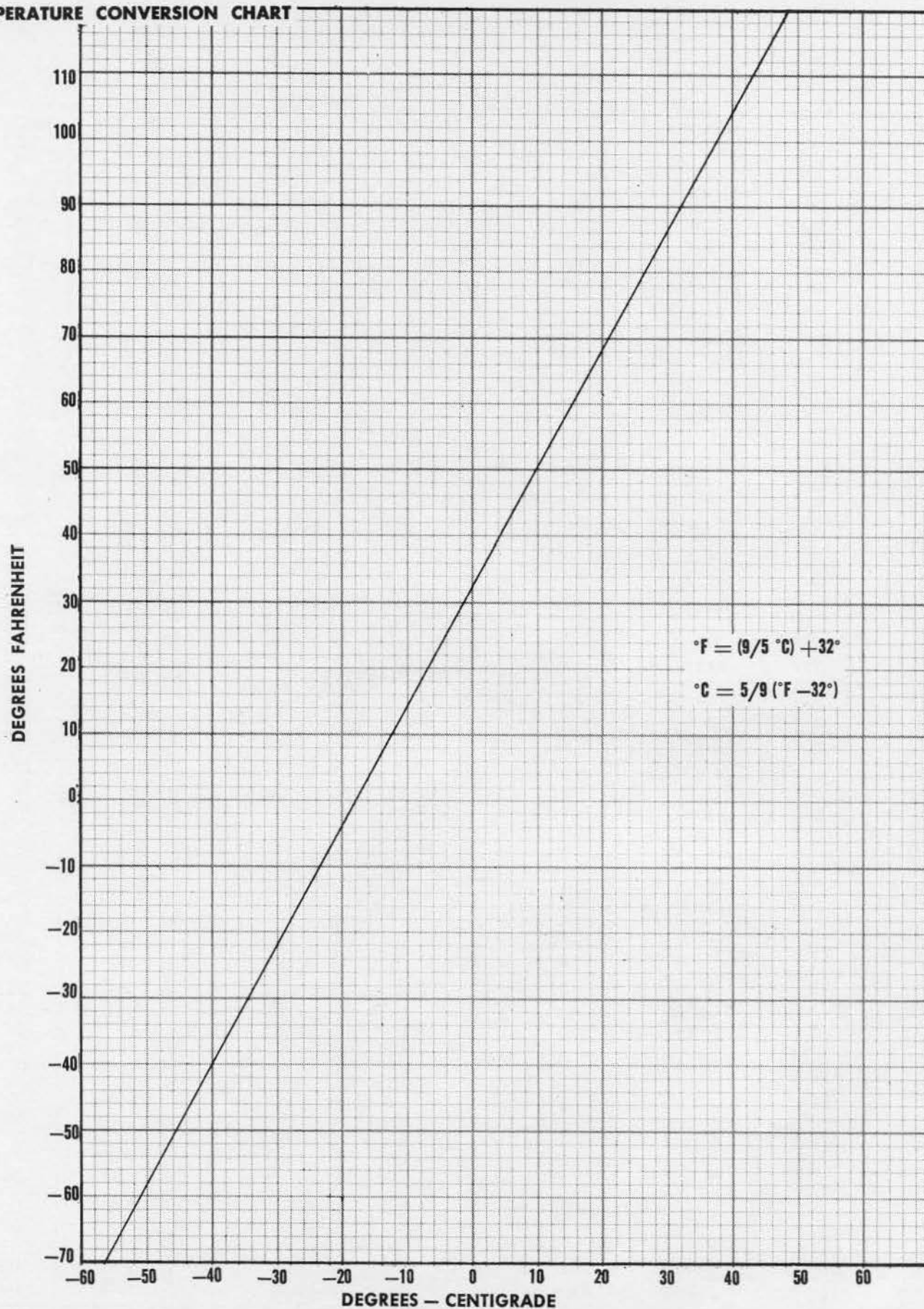


Figure A1-11.

PART 2 TAKE-OFF**TABLE OF CONTENTS**

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TAKEOFF PLANNING.

This part covers the information and charts to be used to obtain takeoff speeds and distances. The terms used in the planning procedure are defined in the following paragraphs. Takeoff performance is affected by a large number of variables, i.e., temperature, altitude, gross weight, and wind, as well as runway surface, use of brakes for directional control, and engine condition. Charts including those variables are provided for takeoff distance, acceleration distance and speed, stopping distance or refusal speed, and minimum afterburner blow-out speeds. Increases in any of these variables except wind tend to increase takeoff ground run to a point where, on a takeoff in which normal techniques are used, the takeoff may not be successfully made in the available runway length. The takeoff chart shows distances for ground run as well as air distances required to clear 50 through 200 foot obstacle heights, takeoff speeds, and rotation speeds. The velocity during takeoff ground run charts show the speed-distance relationship during

the ground run portion of takeoff before rotation speed is reached. The refusal speed chart shows the combined distance traveled in acceleration to any given refusal speed and the distance required for a FULL stop. The minimum afterburner blow-out speeds chart shows the minimum afterburner failure speeds at which takeoff can be continued with Military Thrust without exceeding the available runway length. The takeoff crosswind chart shows the crosswind limits for aircraft gross weight.

The use of these charts for takeoff planning is illustrated by a sample problem.

Note

Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the takeoff crosswind chart if wind is measured at a source other than the runway.

RUNWAY DISTANCE MARKING SYSTEM

The numbering and placement of runway distance markers reflects the distance remaining to the end of the runway in 1000-foot increments. These markers are placed alongside the runway, and the appropriate markers become the acceleration check distance marker and the go, no-go distance marker. The markers are so placed that if a runway length exceeds an even number of thousands of feet, one half of the excess must be added to the distance shown on the markers to determine the actual distance remaining. For example, if a runway is 10,500 ft., the distance remaining at the No. 6 Marker would be $6000 + 1/2(500) = 6250$ ft.

ROTATION SPEED (NOSE WHEEL-OFF)

Rotation Speed (nose wheel-off) is the airspeed at which the nose wheel leaves the runway. The calibrated airspeed (CAS) for rotation is shown at various gross weights.

TAKEOFF SPEED

Takeoff Speed is the airspeed at which the main wheels leave the runway. The calibrated airspeed (CAS) for takeoff is shown at various gross weights.

TAKEOFF INDEX

Takeoff Index is a temperature-altitude factor which is read for the thrust setting used for takeoff. All Takeoff Performance Charts except the Velocity During Takeoff Ground Run and the Air Distance Charts are shown as a function of Takeoff Index.

CLIMB-OUT INDEX

Climb-out Index is a temperature-altitude factor which is read for the thrust setting used for takeoff. Air distances required to clear 50 through 200 foot obstacle heights are shown as a function of Climb-out Index.

TAKEOFF DISTANCES

Ground run distances and air distances to clear 50 through 200 foot obstacle heights with Maximum and Military Thrust are plotted on the takeoff distance charts as functions of Takeoff Index and Climb-out Index, respectively. The distances shown are for normal takeoff techniques on a dry, hard-surface runway and may be used for any configuration if the gross weight at takeoff is considered. These charts account for ambient temperature and

pressure altitude through the index method of presentation. The effect of the remaining variables of gross weight, headwind or tailwind, runway slope (ground run chart) and obstacle height (air distance chart) are also shown. Separate charts are provided for ground run and air distance performance.

Incremental drag for externally loaded configurations has been accounted for at various aircraft gross weights.

TAKEOFF ACCELERATION

Velocity During Takeoff Ground Run

The velocity during takeoff ground run (figures A2-4 and A2-5) charts give ground run distances required to accelerate to any desired calibrated airspeed using Maximum or Military Thrust. These distances are based on the normal takeoff techniques given in Section II and do not take into account substandard engines or excessive use of brakes for directional control.

Refusal Speeds

The highest indicated airspeed to which the aircraft can accelerate and then stop in the available runway length is the refusal speed. The refusal speed chart is based on a Maximum or Military Thrust acceleration to the refusal speed, and then heavy braking to a stop with or without the use of a drag chute. The drag chute reduces the distance required to stop and should be used if possible. The effect of Runway Condition (RCR) (see page A8-1 for explanation of RCR) on refusal speed is also shown. These charts take into account gross weight, external loading as a function of gross weight, and, through the Takeoff Index, pressure altitude and temperature.

MINIMUM AFTERBURNER BLOW-OUT SPEEDS

The lowest indicated airspeed to which the aircraft can accelerate with Maximum Thrust, experience a Maximum Thrust failure, and complete the takeoff with Military Thrust without exceeding the available runway length is the minimum afterburner blow-out speed. The speeds shown on the chart were determined for the clean and externally loaded configurations and are shown for all conditions of gross weight, runway length and wind. Pressure altitude and temperature are accounted for by the Takeoff Index.

WARNING

These speeds are applicable only if the throttle is moved out of the afterburner position immediately, to enable the afterburner nozzle to close. Non-afterburner engine operation with the nozzle open will result in large thrust losses and therefore in significantly longer takeoff distances.

TAKEOFF CROSSWIND CHART

The most critical point in a takeoff with a crosswind is just after lifting the nosewheel and is based on the maximum sideslip angle that the rudder can hold. The takeoff crosswind chart shown in figure A2-9 is based on this consideration. To use this chart, it is required that the aircraft weight, wind direction and velocity be known. An example is given to illustrate the use of the chart. It can be seen that the intersection of two lines should fall in the "recommended" area for a normal takeoff. By normal takeoff it is meant that no overspeed is required. If the intersection falls in the "not recommended" area, takeoff may be achieved if it is seen that some overspeed will place the nosewheel lift-off speed back in the "recommended" area. The amount of overspeed permissible is limited and is a matter of pilot judgment as to what speed he may hold the nosewheel on the ground. After nosewheel lift-off, the ability of the rudder to hold a sideslip angle becomes less critical with increasing angle of attack up to takeoff altitude. After being airborne, the limiting factor in holding a sideslip angle is the lateral control. However, once the aircraft has lifted off, there is no longer any need to hold a sideslip angle, i.e., the aircraft heading may be changed with the rudder to effect any desired path across the ground. No attempt should be made to hold a sideslip angle after takeoff, particularly with large crosswind, because the lateral control cannot keep the wings level when the rudder is fully deflected and because the spoiler causes loss in lift. During the takeoff ground run, the inherent stability of the tricycle landing gear at high speed and the nosewheel steering at low speed eliminate any difficulties from crosswind. The rudder may be used during the ground run, but excessive lateral control deflections will aggravate rather than help the situation.

REFUSAL DISTANCE

The refusal distance is the distance required to accelerate to the refusal speed and is obtained from the velocity during takeoff ground run charts.

GO, NO-GO DISTANCE

Go, no-go distance is defined as the distance traveled in reaching the last 1000-foot runway marker short of the refusal distance. This is the point at which the final decision to continue or to abort the takeoff is made. The minimum speed attained at the go, no-go distance marker is defined as the go, no-go speed and is obtained by subtracting the go, no-go speed tolerance from the normal speed at the go, no-go distance.

GO, NO-GO SPEED TOLERANCE

Speed tolerance is the maximum speed deficiency that is acceptable at the go, no-go distance marker to ensure a safe takeoff in 90 percent of the available runway. If acceleration is deficient to the extent that the speed tolerance is exceeded at the go, no-go distance, a serious malfunction of the aircraft is indicated and the takeoff should be aborted.

ACCELERATION CHECK DISTANCE

The final decision to continue or to abort a takeoff is made at the go, no-go point; however, a preliminary check is made before reaching the go, no-go point to monitor the progress of the takeoff. This check is made at the acceleration check point and is defined as the distance to the runway marker, which is 2000 feet short of the go, no-go point. This distance is established by subtracting 2000 feet from the go, no-go distance. The acceleration check speed is the minimum speed allowable at this check distance marker and is established by obtaining the speed for the distance 2000 feet short of the go, no-go distance on the Maximum or Military Thrust velocity during takeoff ground run charts and subtracting the go, no-go speed tolerance.

TAKEOFF PERFORMANCE - SAMPLE PROBLEM

Complete the takeoff portion of the Takeoff and Landing Data Card in the checklist for a Maximum Thrust takeoff with water injection. Also, determine total takeoff distance over 100 ft obstacle height and minimum afterburner blow-out speed.

Given:

Gross Weight	48,000 LB
Runway Length	8,000 FT
O.A.T.	20°C

Pressure Altitude	2,000 FT
Wind (Headwind Component)	10 KN
Runway Gradient	None
R.C.R.	23

Solution:

- 1. Enter Sample Takeoff Speed Chart (page A2-4) at a gross weight of 48,000 lb, (A); follow a vertical path upward to (B) and (C) then move directly across to (D) and (E) and read rotation speed and takeoff speed (178 KCAS and 188 KCAS), respectively.

Note

The method for reading the velocity at obstacle height (climb-out speed) is the same as shown in step 1.

- 2. Enter Sample Takeoff Index Chart (page A2-4) at outside air temperature 20°C, (F); move vertically to the 2000 ft pressure altitude, (G); move horizontally to the Maximum Thrust with water injection line, (H); drop down to Takeoff Index Scale and read Takeoff Index = 9.55 (J).
- 3. Enter Sample Climb-Out Index Chart (page A2-4) at outside air temperature = 20°C, (AA); move vertically to the 2000 ft pressure altitude, (BB); move horizontally to the maximum thrust with water injection line (CC); drop down to Climb-Out Index Scale and read Climb-Out Index = 9.75, (DD).
- 4. Enter Sample Takeoff Ground Run Chart (page A2-6) at Takeoff Index (step 2 = 9.55, (K); move horizontally to takeoff gross weight = 48,000 lb, (L); move vertically downward until the zero wind condition is reached at (M) and read ground run (no wind) = 5150 ft. From (M) parallel the guide lines until a 10 knot headwind is reached at (N), and proceed vertically to the zero % grade at (O). From (O) move vertically downward to the Ground Run Scale and read ground run distance = 4650 ft, (P).

Note

SAMPLE PROBLEM INITIAL CONDITIONS STATE NO RUNWAY SLOPE.

However, if a correction for runway slope is required proceed as follows: For a 2% downhill slope, correct the ground run distance by continuing from (O) (step 4) parallel to the downhill guide lines until the 2% condition is reached at (Q) and proceed vertically downward to the Ground Run Scale to read the corrected ground run = 4400 ft, (R).

- 5. Enter Sample Air Distance Chart (page A2-6) at Climb-Out Index (step 3) = 9.75, (EE); move horizontally to takeoff gross weight = 48,000 lb, (FF) and move vertically downward to base line, (GG). From (GG) parallel the guide lines until a 100 ft obstacle height is reached at (HH). From (HH) proceed vertically to the zero-wind condition at (JJ) and parallel the guide lines until a 10 knot headwind is reached at (KK). From (KK) proceed vertically to the Air Distance Scale and read air distance = 2500 ft, (LL). Total takeoff distance = ground run plus air distance = 4650 + 2500 = 7150 ft.

Note

Assume drag chute deployed.

- 6. Enter Sample Refusal Speed Chart (page A2-7) at Takeoff Index (step 2) = 9.55 at A' and move across to runway length available = 8000 ft, (B'). From B' drop vertically to the curve marked "With Drag Chute" stopping at takeoff gross weight = 48,000 lb, (C') move across to intercept RCR = 23 at (D') and drop down to the scale to read refusal speed = 174 KCAS (E') for zero-wind condition. Add 10 knots to zero-wind refusal speed to adjust for headwind condition; (147 + 10) = 157 KCAS.
- 7. Enter Sample Minimum Afterburner Blow-Out Speed Chart (page A2-7) at Takeoff Index (step 2) = 9.55, (T) move across to the runway length available at 8000 ft, (U), drop down to the takeoff gross weight of 48,000 lb, (V) move across stopping at the zero-wind condition at (W) and follow parallel to the headwind guide line until the 10 knot wind is reached at (X). Proceed horizontally to the scale and read afterburner blow-out speed = 169 knots, (Y).

Note

Takeoff may therefore be safely aborted at any time before 157 KCAS (refusal speed)

Note (Continued)

is reached. If the afterburner should fail between 157 KCAS and 169 KCAS prepare to engage the barrier. If the afterburner should fail after 169 KCAS has been attained, takeoff can be completed with military thrust.

8. Enter Sample Velocity During Ground Run Chart (page A2-6) at Takeoff Speed (step 1) = 188 KCAS and ground run (no wind, step 4-M) distance = 5150 ft at (Q). Parallel the guide line to intersect the zero-wind refusal speed, 147 KCAS, and read refusal distance = 3050 ft at (R). Go, no-go distance is therefore 3000 ft and acceleration check distance = $3000 - 2000 = 1000$ ft. Continue to parallel guide line from (R) to read zero-wind normal speed at the go, no-go marker = 146 KCAS at (S) and zero-wind normal speed at the acceleration check marker = 86 KCAS at (S'); or $(146 + 10) = 156$ KCAS and $(86 + 10) = 96$ KCAS respectively, with wind.

9. To determine go, no-go tolerance, compute 90% of runway length (0.9×8000) = 7200 ft. Reenter velocity during ground run curve at takeoff speed = 188 KCAS and distance = 7200 ft (Q'), and parallel guide line until the go, no-go distance (3000 ft) is intersected

at (R') and read zero-wind speed = 126 KCAS. Thus, the maximum speed deficiency that is acceptable at the go, no-go distance is $(146 - 126) = 20$ KCAS.

10. Compute Go, No-Go Speed. $156 - 20 = 136$ KCAS.

Compute Acceleration Check Speed. $96 - 20 = 76$ KCAS.

11. Fill out Takeoff Data Card and summarize additional data.

Acceleration Check . . . 76 K at 1000 FT
(Marker No. 7)

Rotation Speed 178 K

Go, No-Go Check . . . 136 K at 3000 FT
(Marker No. 5)

Refusal Speed 157 K

Takeoff 188 K at 4650 FT

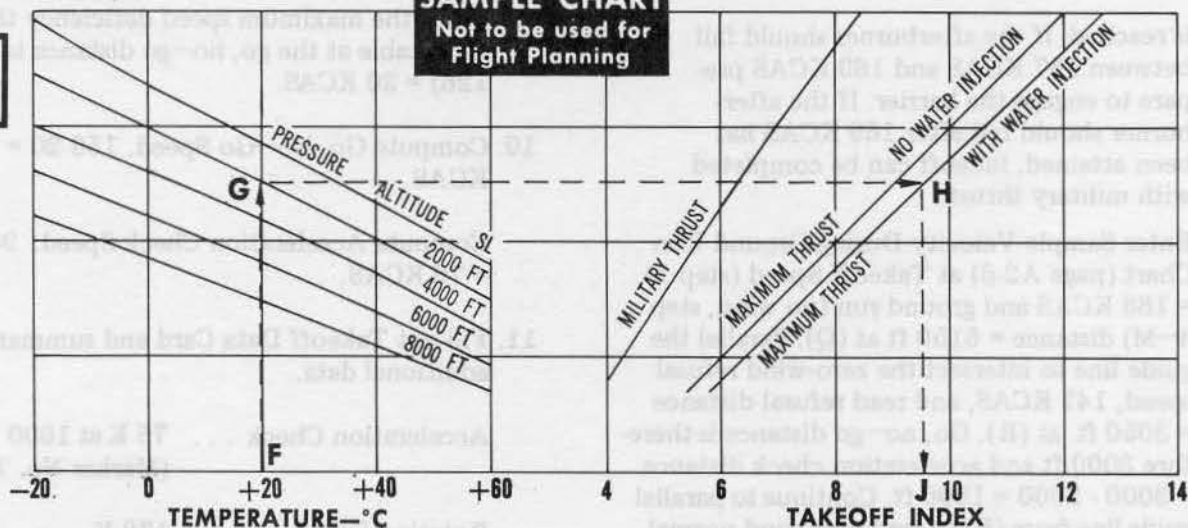
Total distance over 100 ft obstacle is 7150 ft.
Minimum afterburner blow-out speed is 169 Kn.

TAKEOFF INDEX

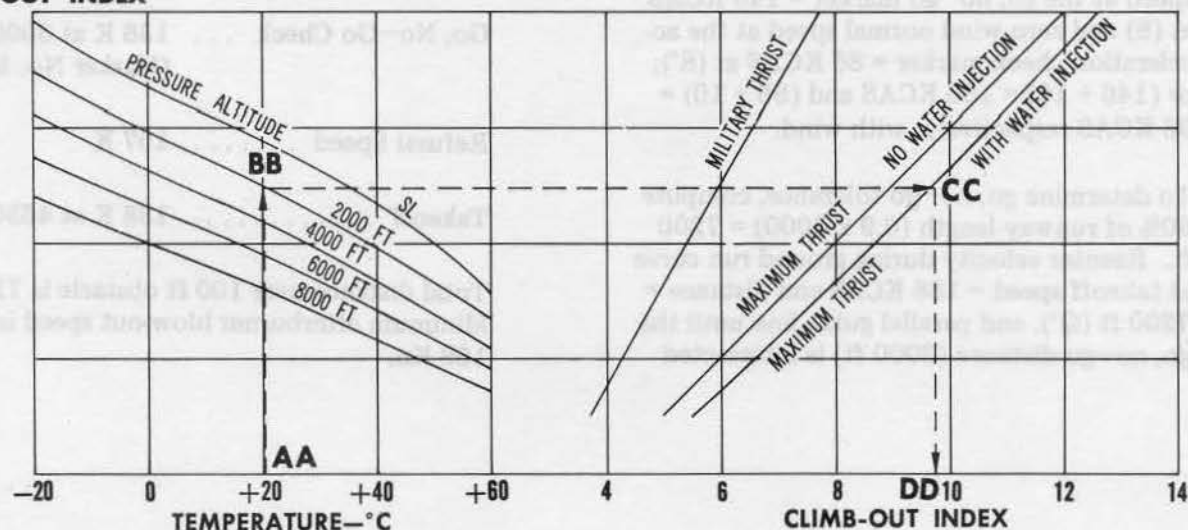
D

SAMPLE CHART

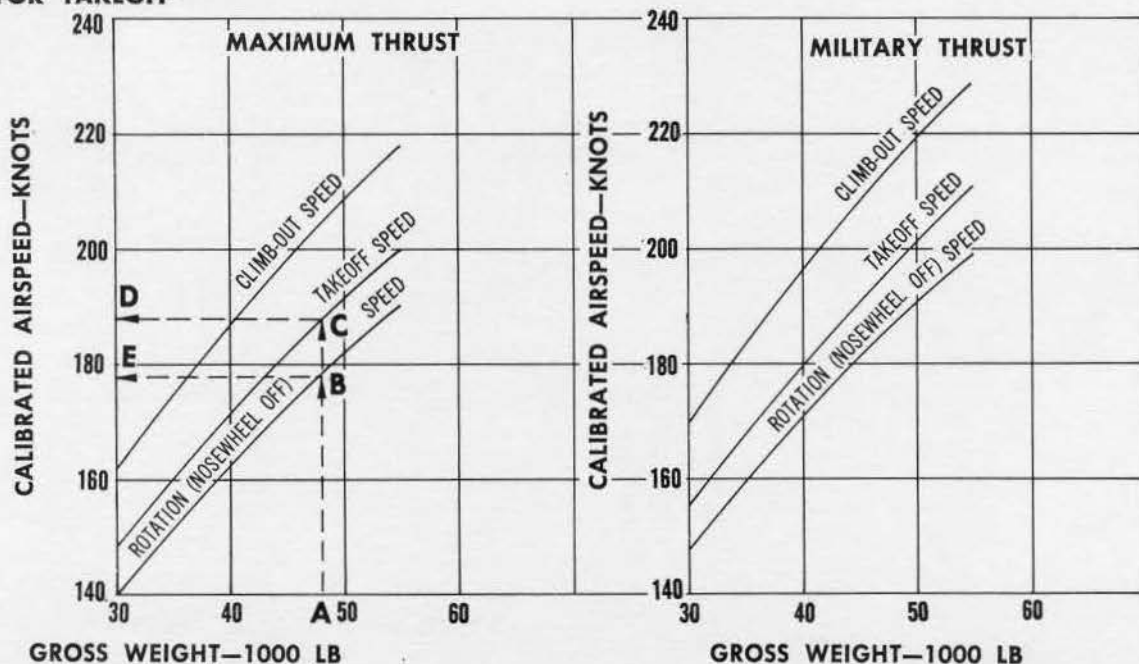
Not to be used for Flight Planning

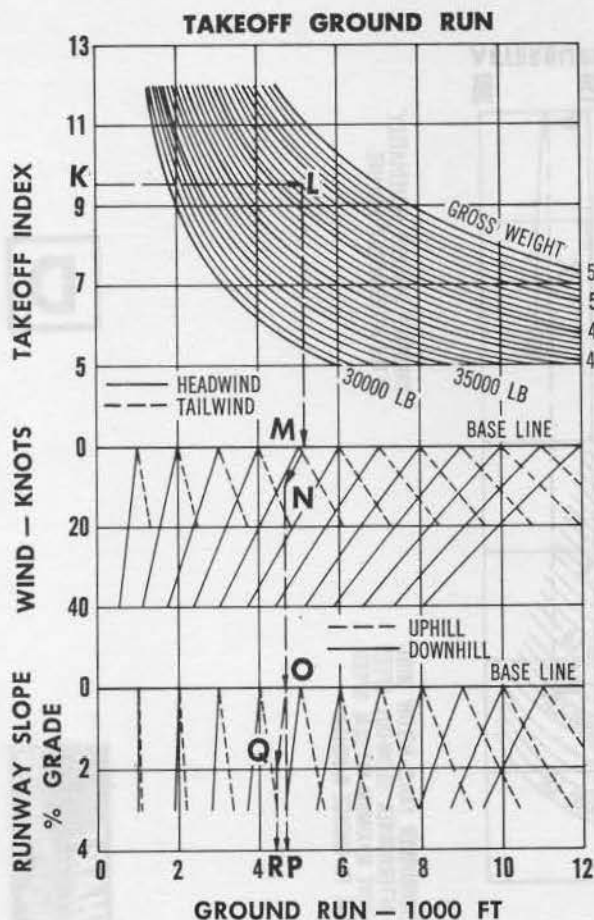
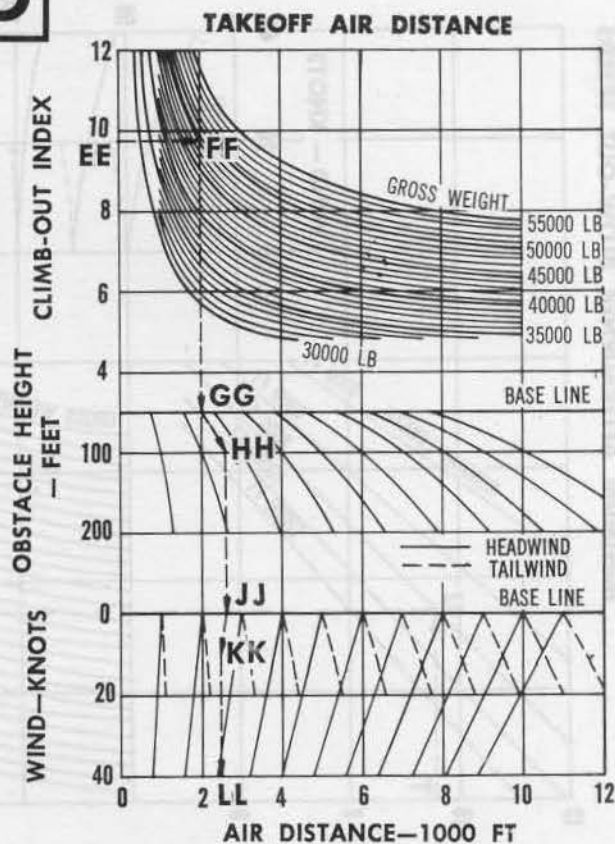


CLIMB-OUT INDEX

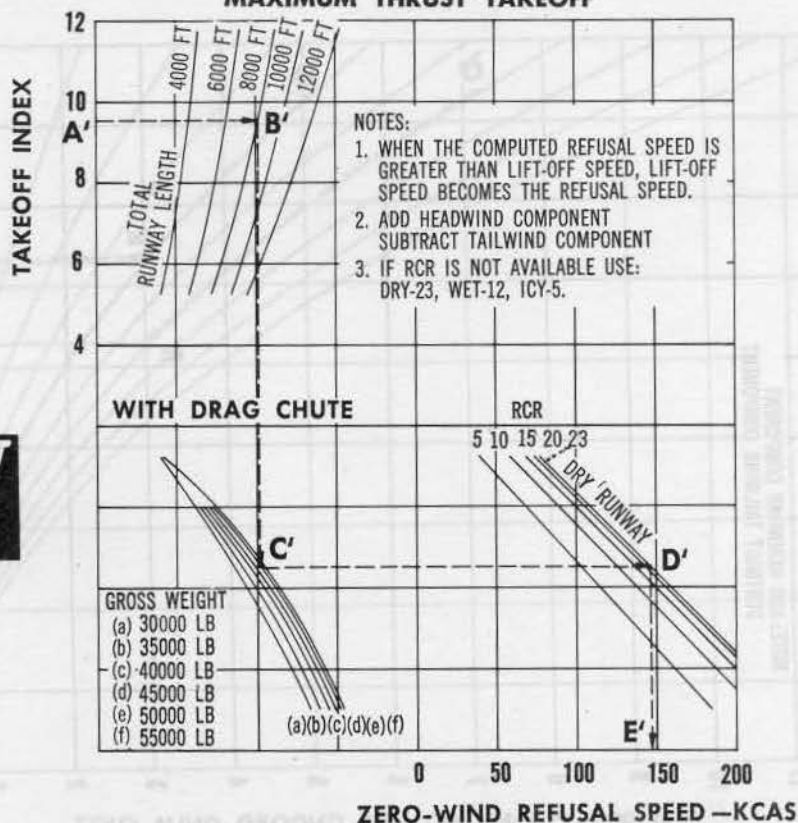


SPEEDS FOR TAKEOFF



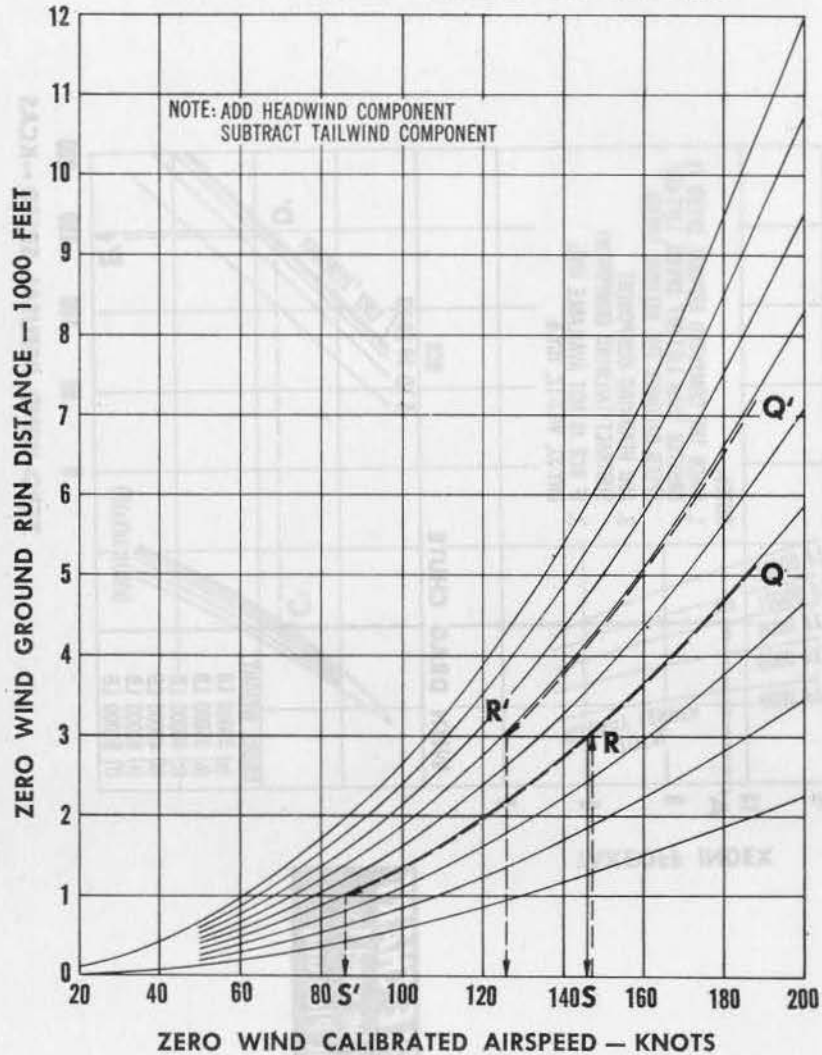
**D**

**REFUSAL SPEED
MAXIMUM THRUST TAKEOFF**

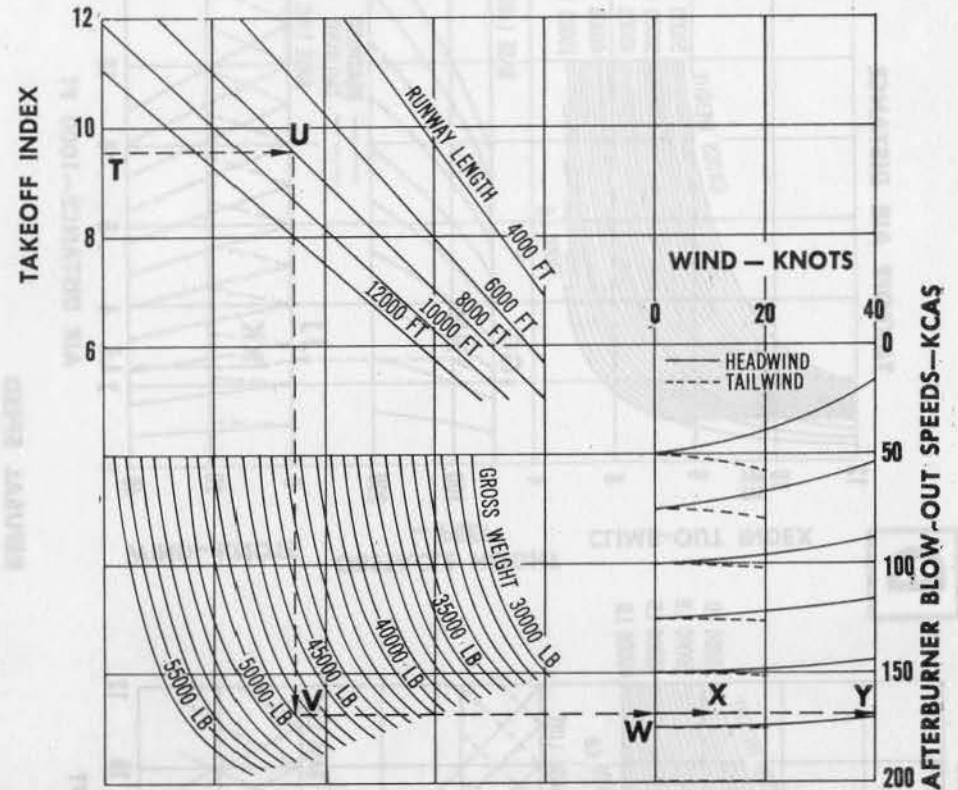


SAMPLE CHART
Not to be used for
Flight Planning

VELOCITY DURING TAKEOFF GROUND RUN



MINIMUM AFTERBURNER BLOW-OUT SPEEDS



NOTE:
IF AFTERBURNER FAILS BELOW MINI-
MUM AFTERBURNER BLOW-OUT SPEED
AND ABOVE MAXIMUM REFUSAL SPEED,
PREPARE TO ENGAGE BARRIER.

THROTTLE INBOARD IMMEDIATELY
AFTER AFTERBURNER FAILURE

SAMPLE CHART
Not to be used for Flight Planning



TAKEOFF
LE FLAPS — 100%
TE FLAPS — 100%

D

model: F-105D fuel density: 6.5 LB/GAL
engine: J75-P-19W data date: 1 FEB 1963
fuel grade: JP-4 data basis: FLIGHT TEST

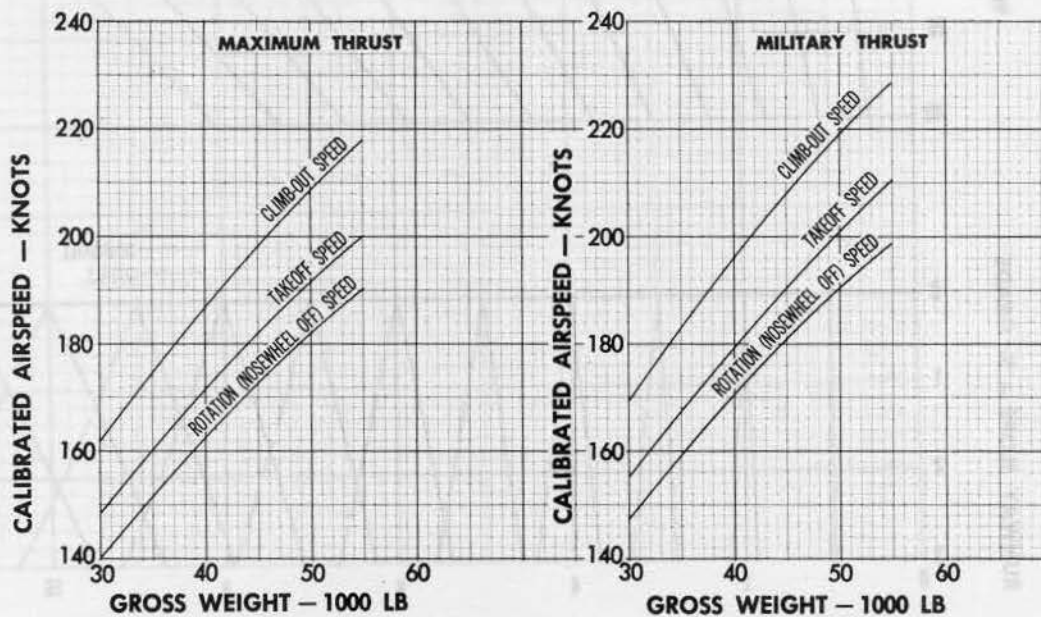
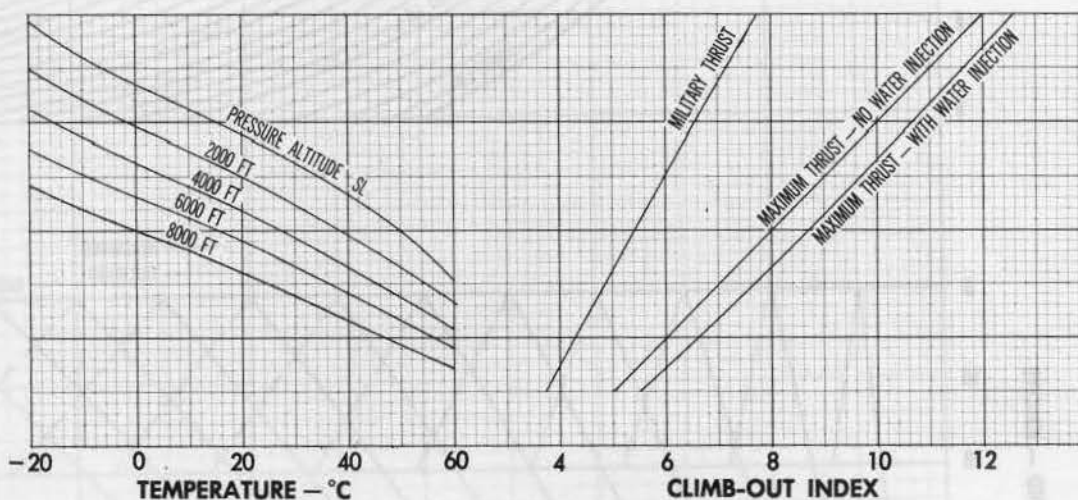
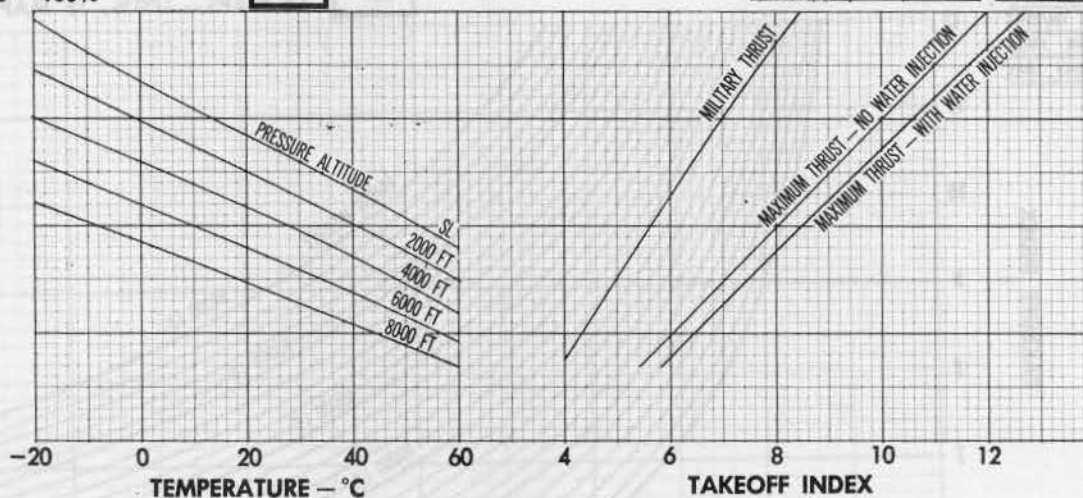


Figure A2-1

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

D

TAKEOFF GROUND RUN
HARD SURFACE RUNWAY
 LE FLAPS — 100%, TE FLAPS — 100%

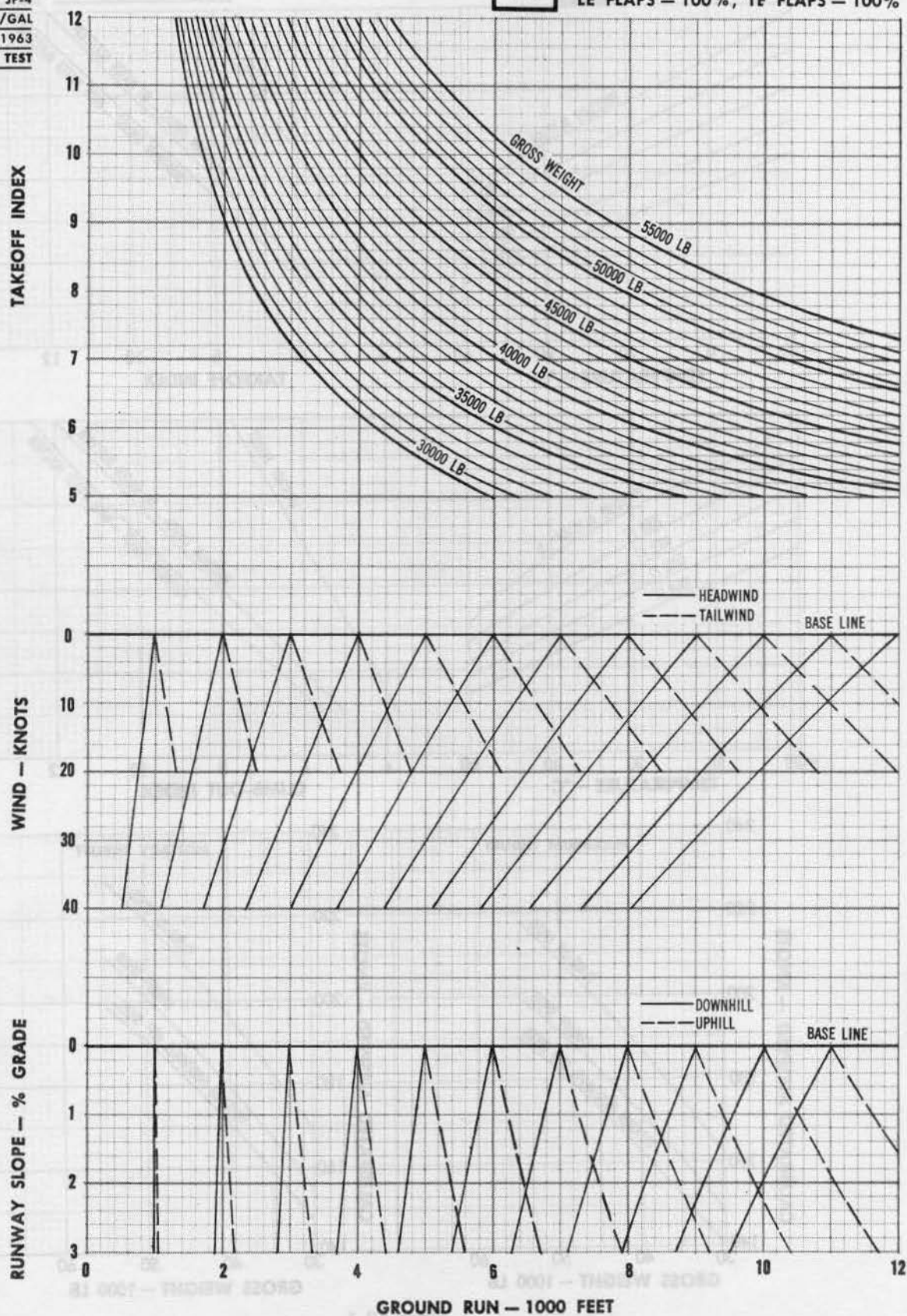


Figure A2-2

TAKEOFF AIR DISTANCE

LE FLAPS — 100%,
TE FLAPS — 100%

D

Model: F-105D
engine: J75-P-19W
fuel grade: JP-4

fuel density: 6.5 LB/GAL
data date: 1 FEB. 1963
data basis: FLIGHT TEST

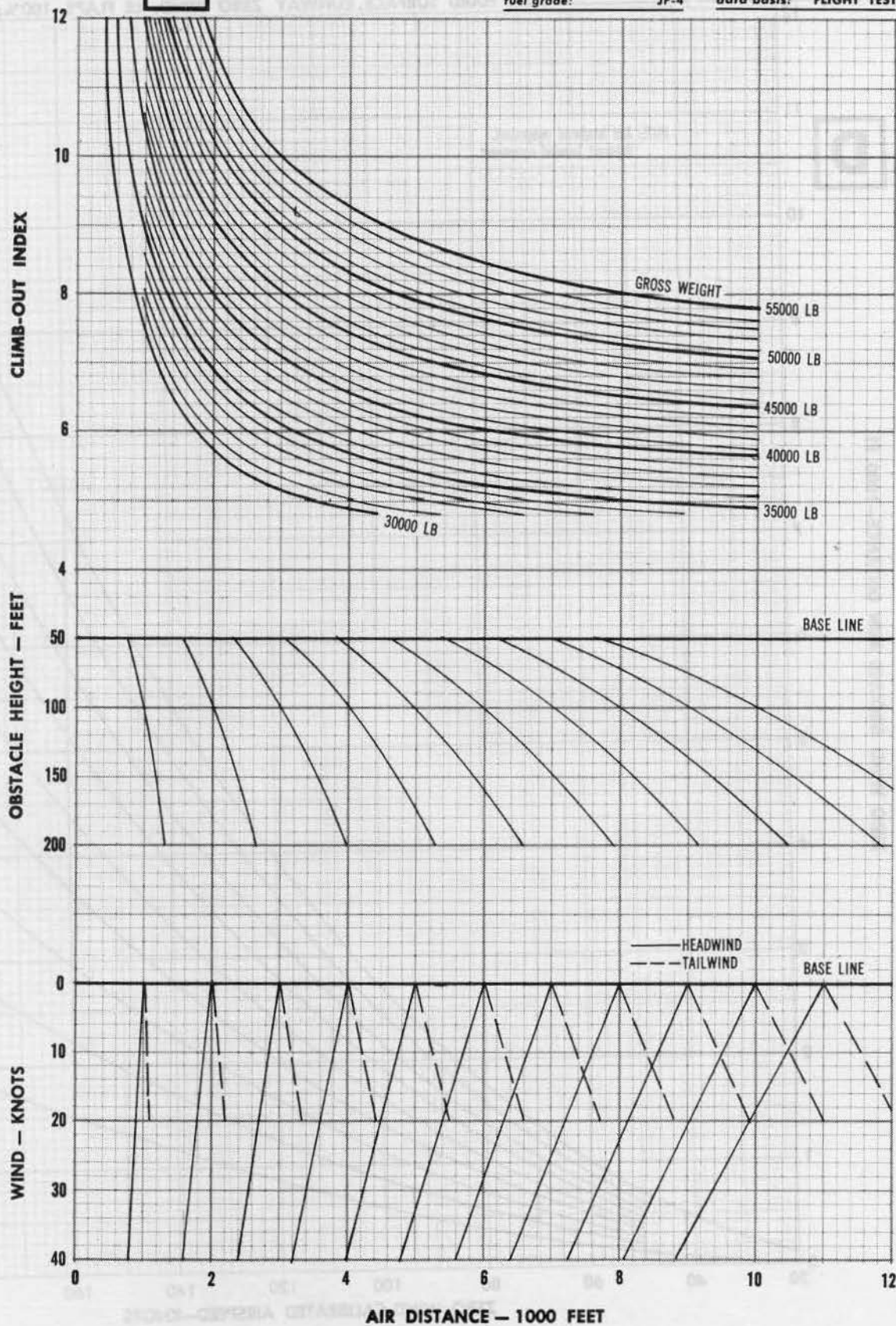


Figure A2-3

model: F-105D fuel density: 6.5 LB/GAL
 engine: J75-P-19W data date: 1 FEB 1963
 fuel grade: JP-4 data basis: FLIGHT TEST

VELOCITY DURING TAKEOFF GROUND RUN
MAXIMUM THRUST (WITH OR WITHOUT WATER INJECTION)
HARD SURFACE, RUNWAY ZERO WIND, LE FLAPS—100%; TE FLAPS—100%

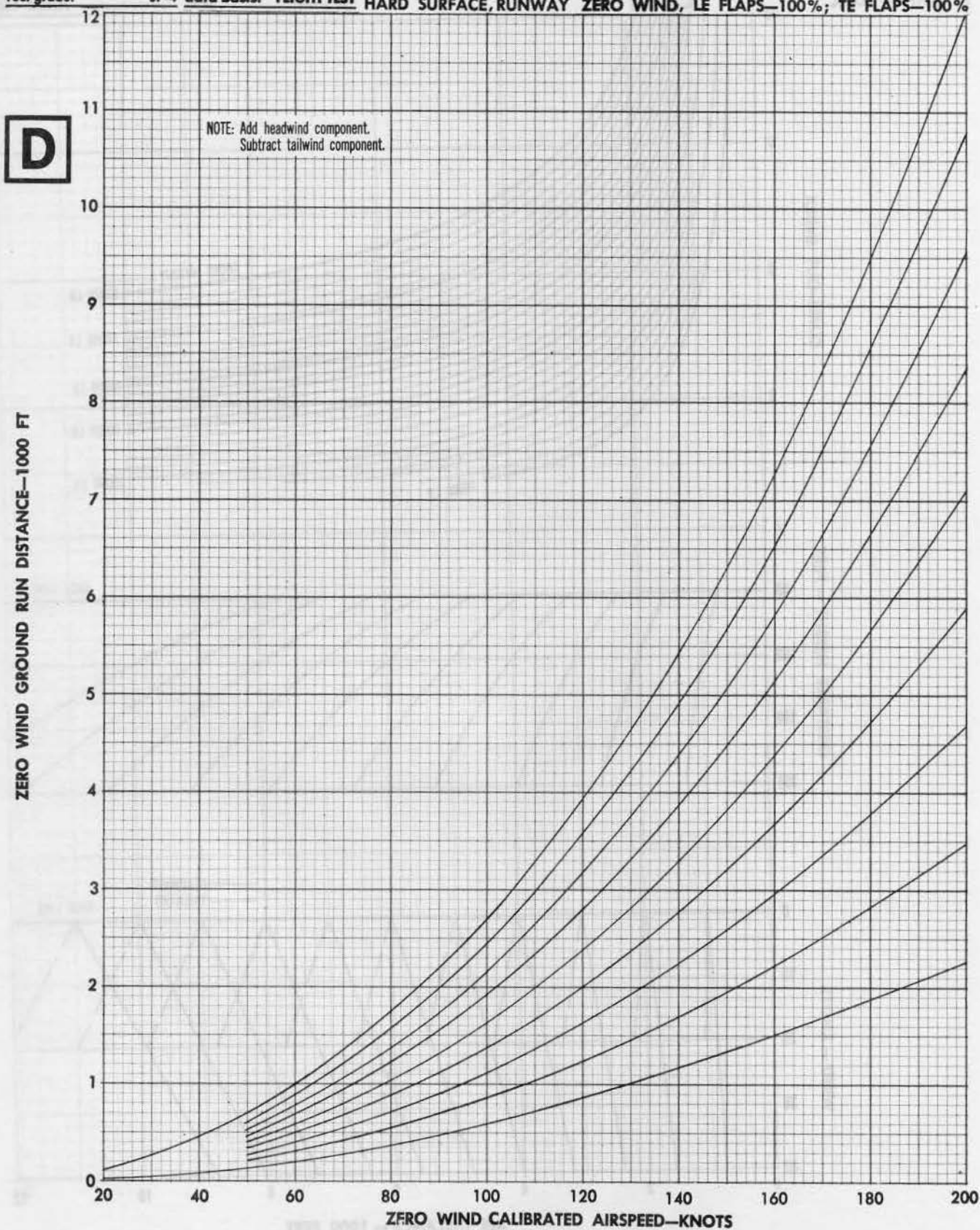


Figure A2-4

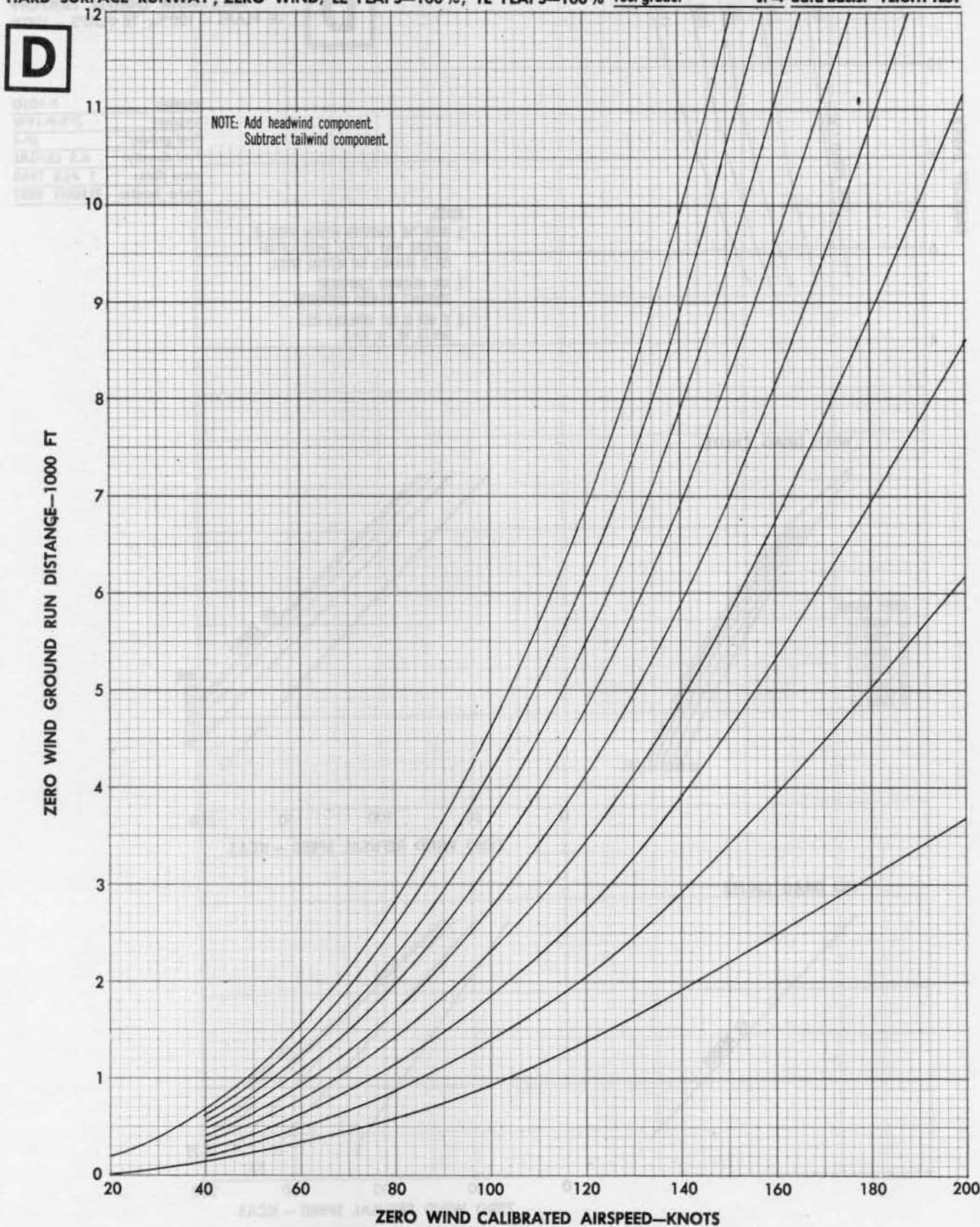
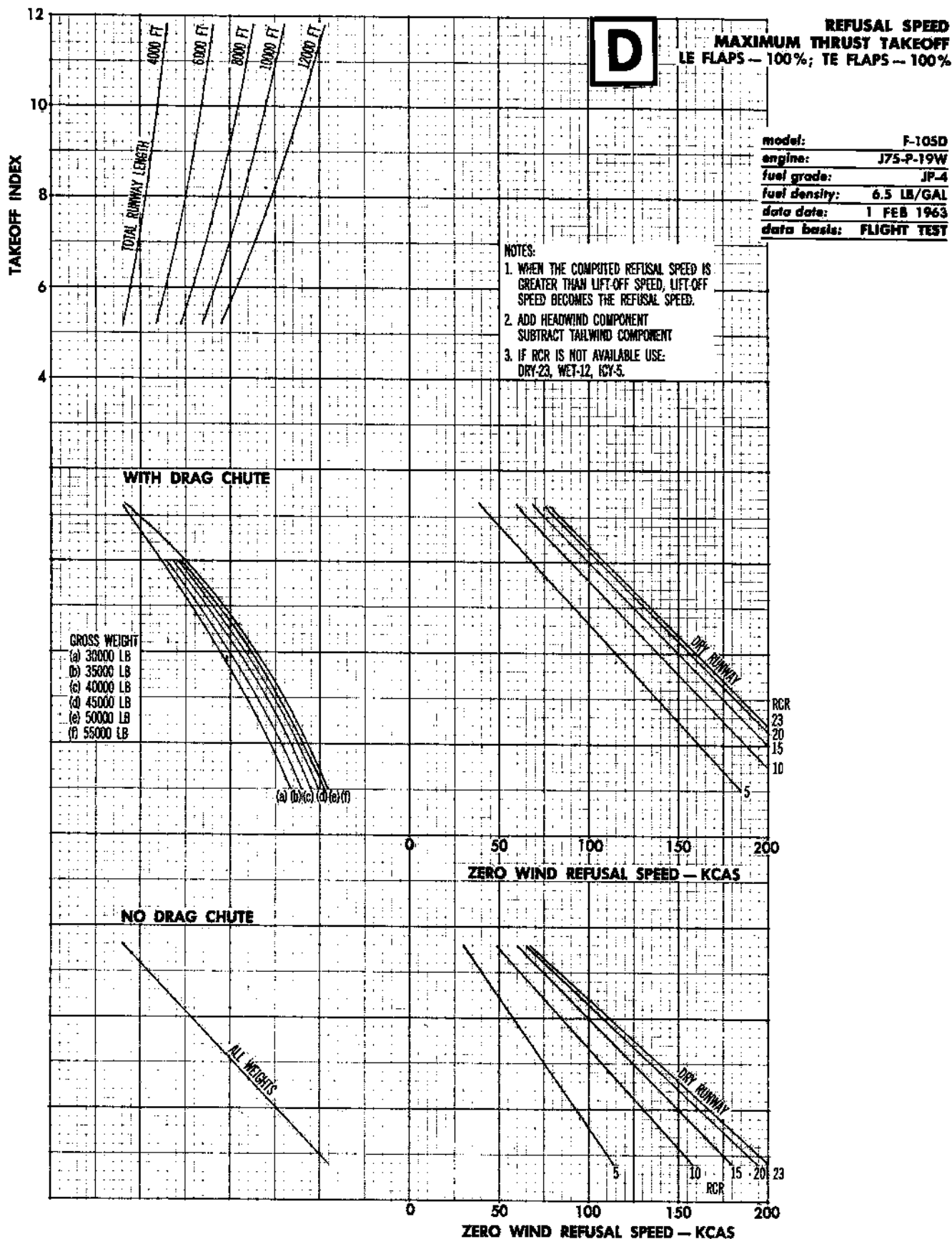
VELOCITY DURING TAKEOFF GROUND RUN**MILITARY THRUST****HARD SURFACE RUNWAY, ZERO WIND, LE FLAPS—100%; TE FLAPS—100%****model:** F-105D **fuel density:** 6.5 LB/GAL**engine:** J75-P-19W **data date:** 1 FEB 1963**fuel grade:** JP-4 **data basis:** FLIGHT TEST

Figure A2-5



REFUSAL SPEED
MILITARY THRUST TAKEOFF
 LE FLAPS — 100%;
 TE FLAPS — 100%



model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST

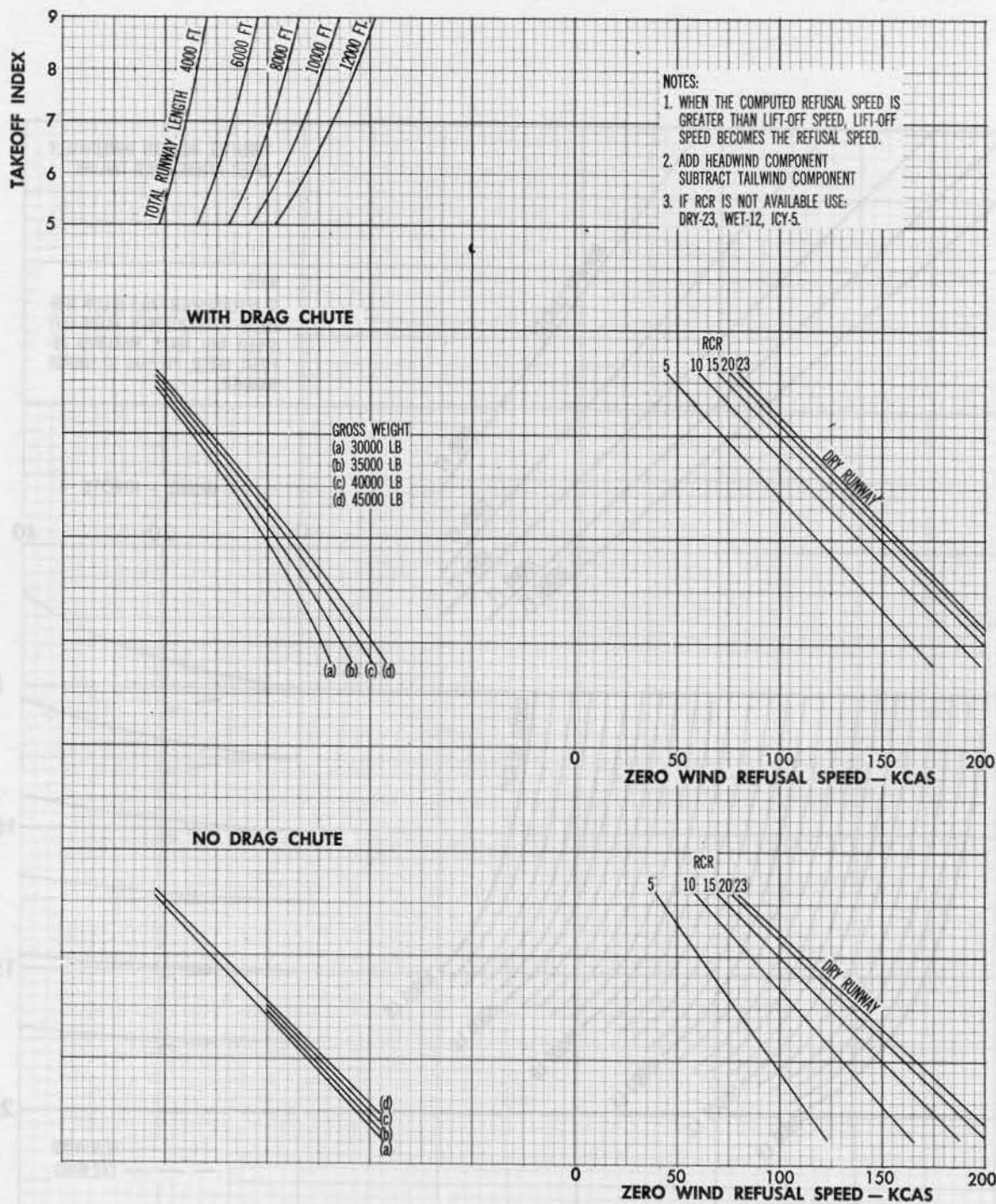


Figure A2-7

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST



MINIMUM AFTERBURNER BLOW-OUT SPEEDS

LE FLAPS — 100%; TE FLAPS — 100%
 HARD SURFACE RUNWAY

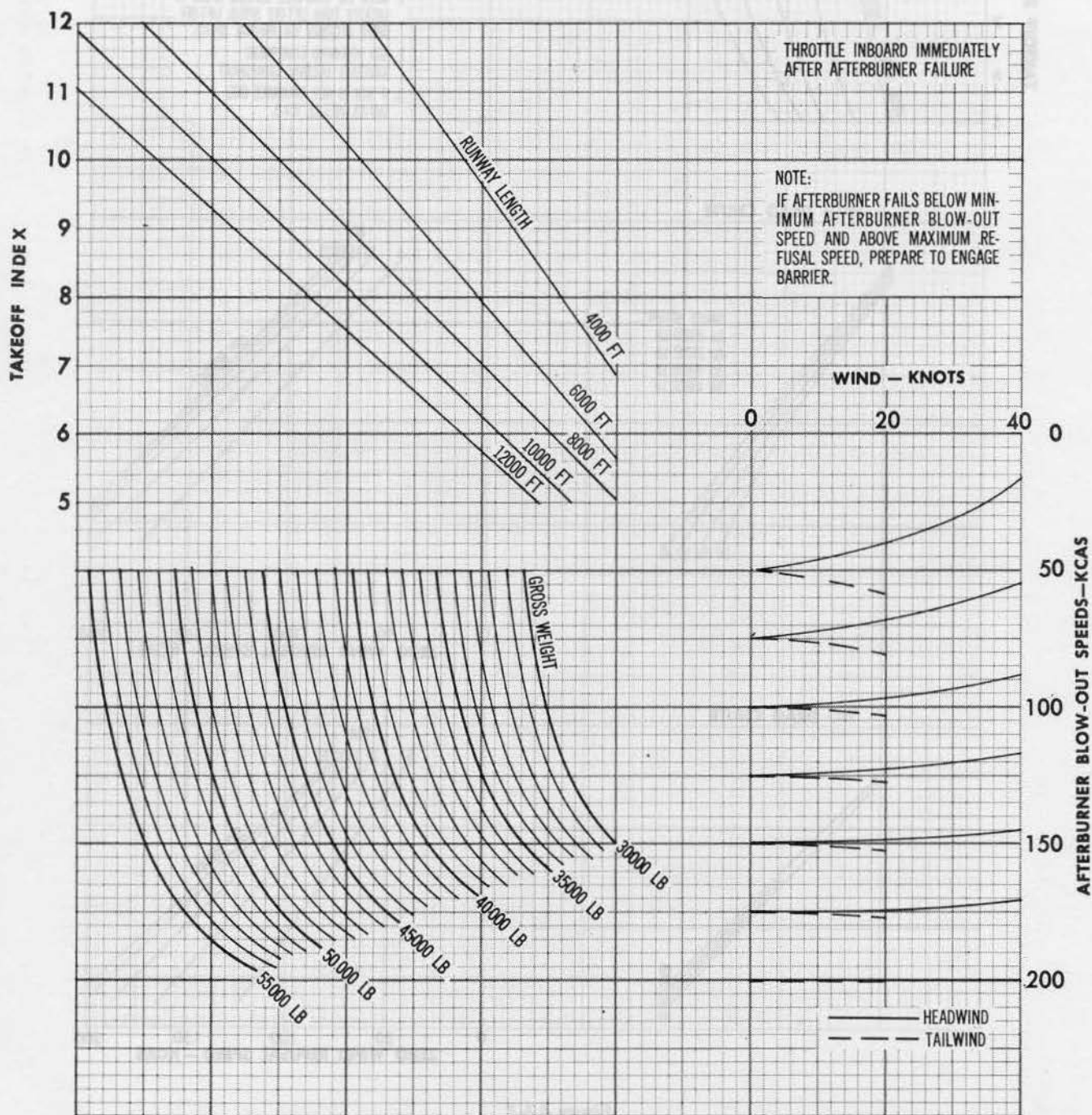
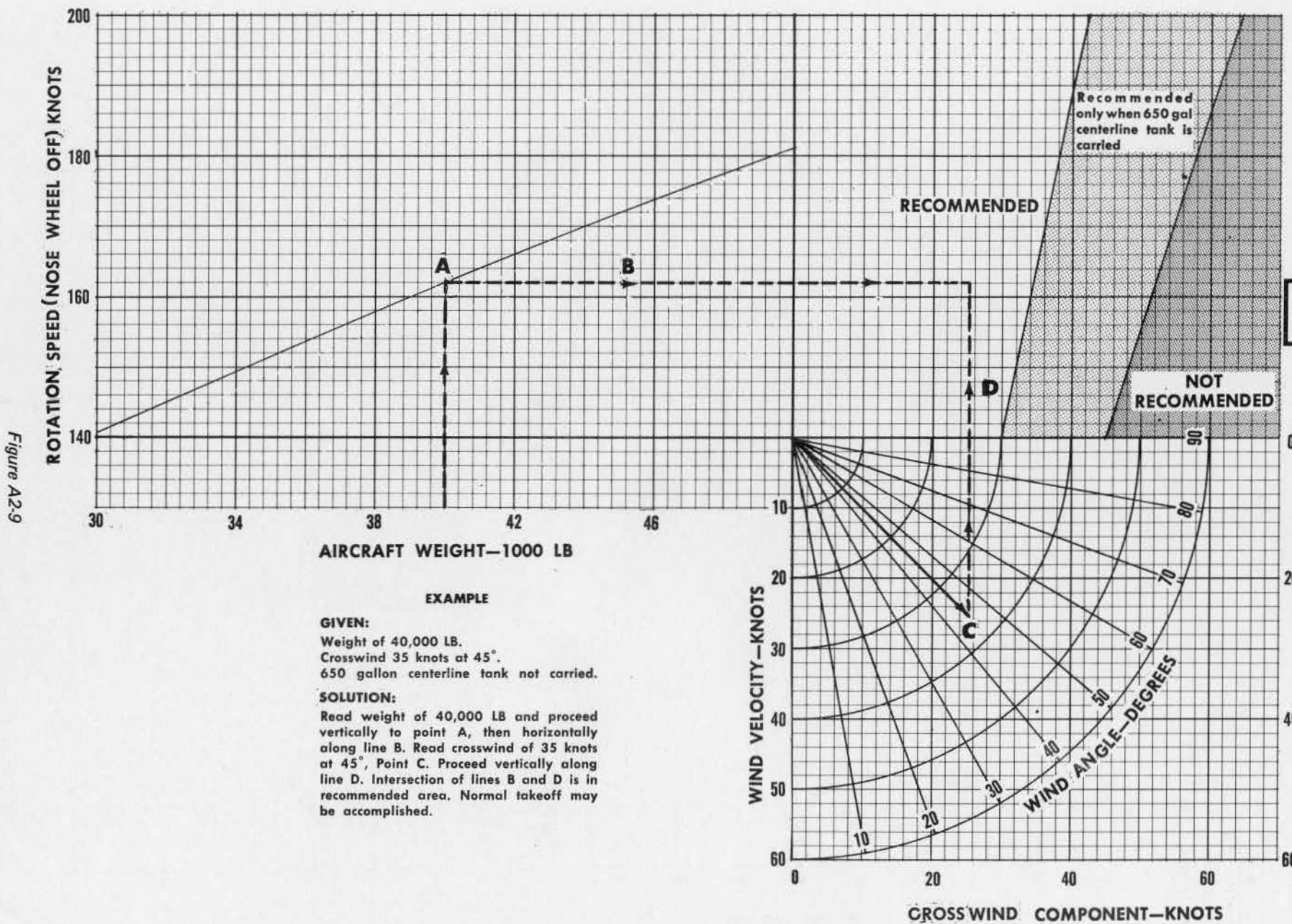


Figure A2-8

D



PART 3 CLIMB**TABLE OF CONTENTS**

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CLIMB INFORMATION

Charts in this part enable the pilot to determine the fuel, time and distance to climb between any two altitudes, with either Maximum or Military Thrust setting. Both thrust settings are shown for a constant Recommended Mach Number climb, as well as for a speed schedule of 400 KCAS to the Recommended Mach Number.

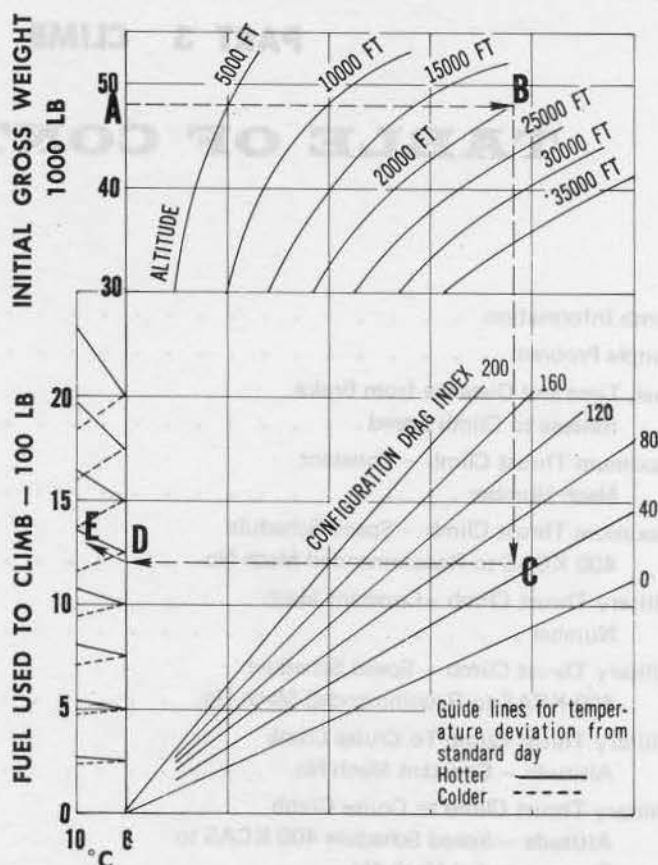
In addition, Military Thrust climb charts are shown for the recommended KC-135/F105 Buddy Climb Speed schedule, 325 KCAS.

Fuel time and distance from brake release to 400 KCAS are also presented for both Military and Maximum Thrust takeoff.

**MILITARY THRUST CLIMB
CONSTANT MACH NO.**

SAMPLE CHART

 Not to be used for
Flight Planning

FUEL USED

EXAMPLE I.

Conditions: Config. Clean + 650 Gal. Tank (Centerline + (2) 450 Gal. Tanks Inb'd)

Initial Gross Weight: 48,000 lb

Initial Altitude: Sea Level

Final Altitude: 20,000 ft

Climb Thrust Setting: Military

Climb Speed Schedule: Recommended Constant Mach Number

Ambient Temperature for last 10,000 ft: Standard Day + 8°C

Find: Fuel, Distance and Time to climb and the recommended climb Mach Number

Solution:

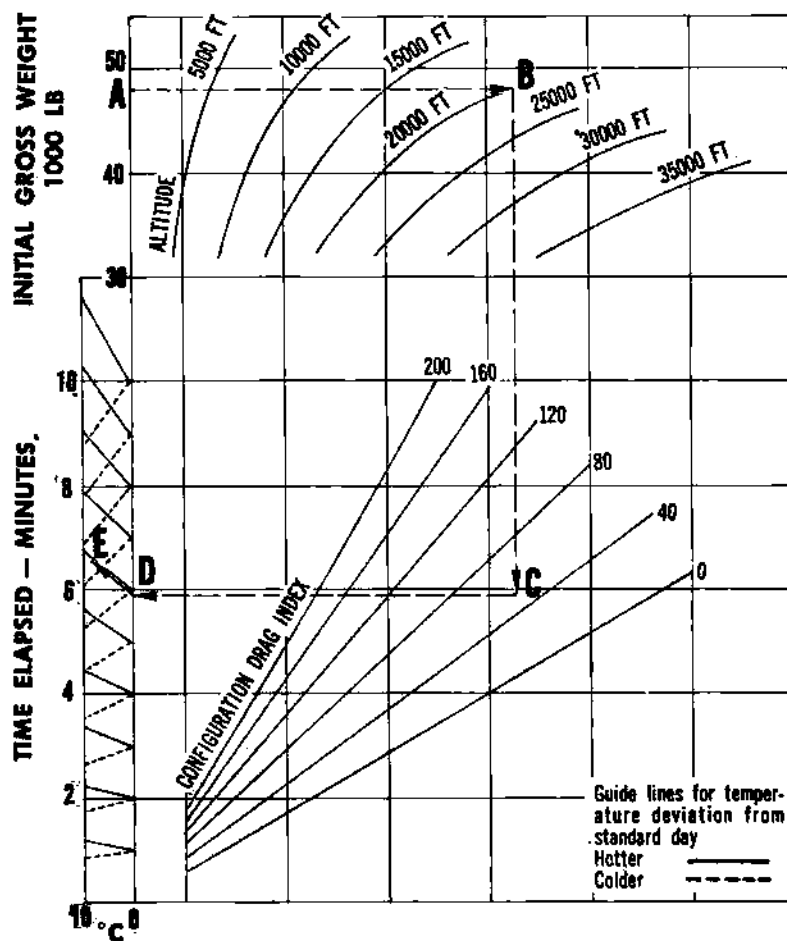
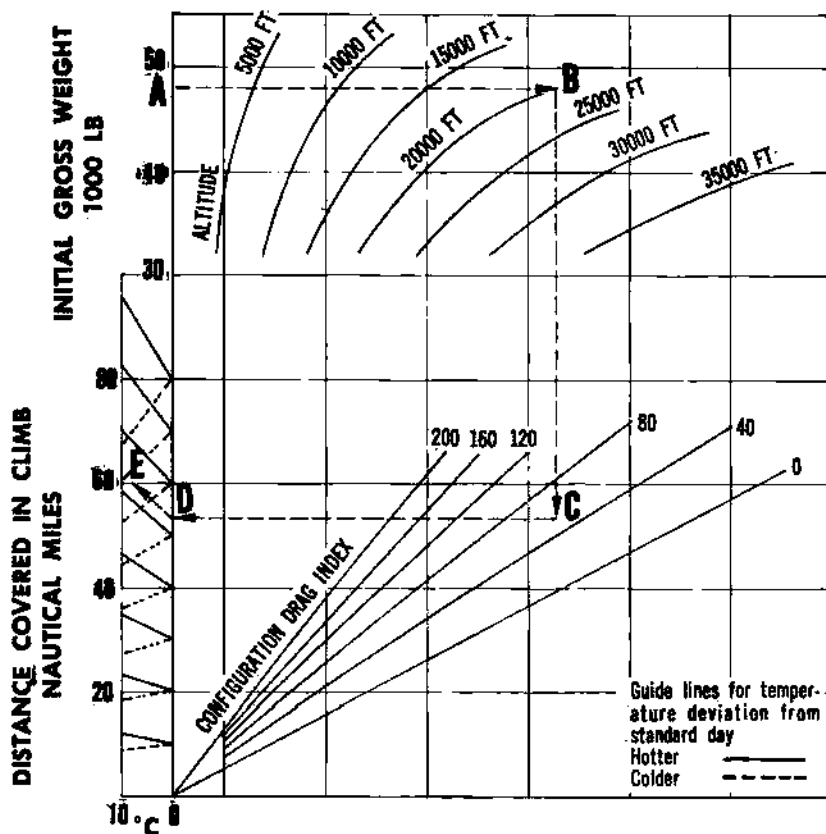
1. Determine the configuration drag index from the table on Figure A1-5 by adding the various store drag numbers.

Store	Location	Store Drag Number
(1) 650 Gal. Tank	Centerline	24
(1) 450 Gal. Tank	Right inboard	14
(1) 450 Gal. Tank	Left inboard	14
Configuration Drag Index		= 52

2. Enter sample chart page A3-2 at a gross weight of 48,000 lb (A)
3. Move horizontally to an altitude of 20,000 ft, (B)
4. Move vertically to a config. drag index of 52 (C)
5. Move horizontally to the left and read Standard Day fuel used of 1200 lb, (D)
6. Move along parallel to the solid (hotter) guide line to a temperature deviation of 8°C and read a fuel used of 1280 lb, (E)
7. Enter sample chart at top of page A3-3 at a gross weight of 48,000 lb, (A)
Repeat steps 3, 4, 5, and 6 and read a distance traveled of 60 N.Mi., (E)
8. Enter sample chart at bottom of page A3-3 at a gross weight of 48,000 lb, (A)
Repeat steps 3, 4, 5, and 6 and read a time elapsed of 6.5 min, (E)
9. Enter the Mach number table on figure A3-3 and at a configuration drag index of 52 (between 40 and 80) and read the recommended climb Mach Number of 0.86 and the equivalent calibrated airspeed at each altitude.

**MILITARY THRUST CLIMB
CONSTANT MACH NO.**
D
DISTANCE COVERED
SAMPLE CHART

 Not to be used for
Flight Planning

TIME ELAPSED


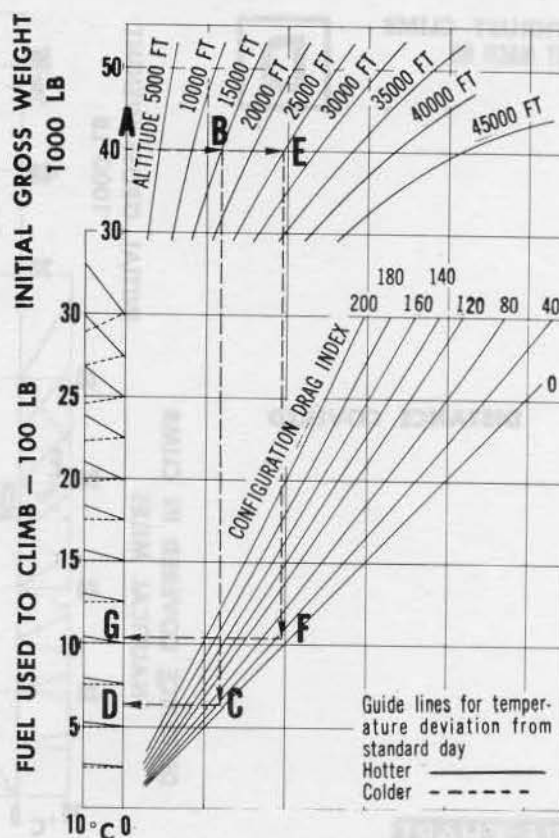
**MAXIMUM THRUST CLIMB
CONSTANT MACH NO.**

D

FUEL USED

SAMPLE CHART

**Not to be used for
Flight Planning**



EXAMPLE II.

Conditions: Config: Clean + (2) 450 Gal. Tanks

Initial Gross Weight: 40,000 lb

Initial Altitude: 15,000 ft

Final Altitude: 25,000 ft

Climb Thrust Setting: Maximum

Climb Speed Schedule: Constant recommended Mach No.

Ambient Temperature: Standard Day

Find: Fuel used to climb

Solution:

1. Determine the configuration drag index from the table on figure A1-5 by adding the various store drag numbers.

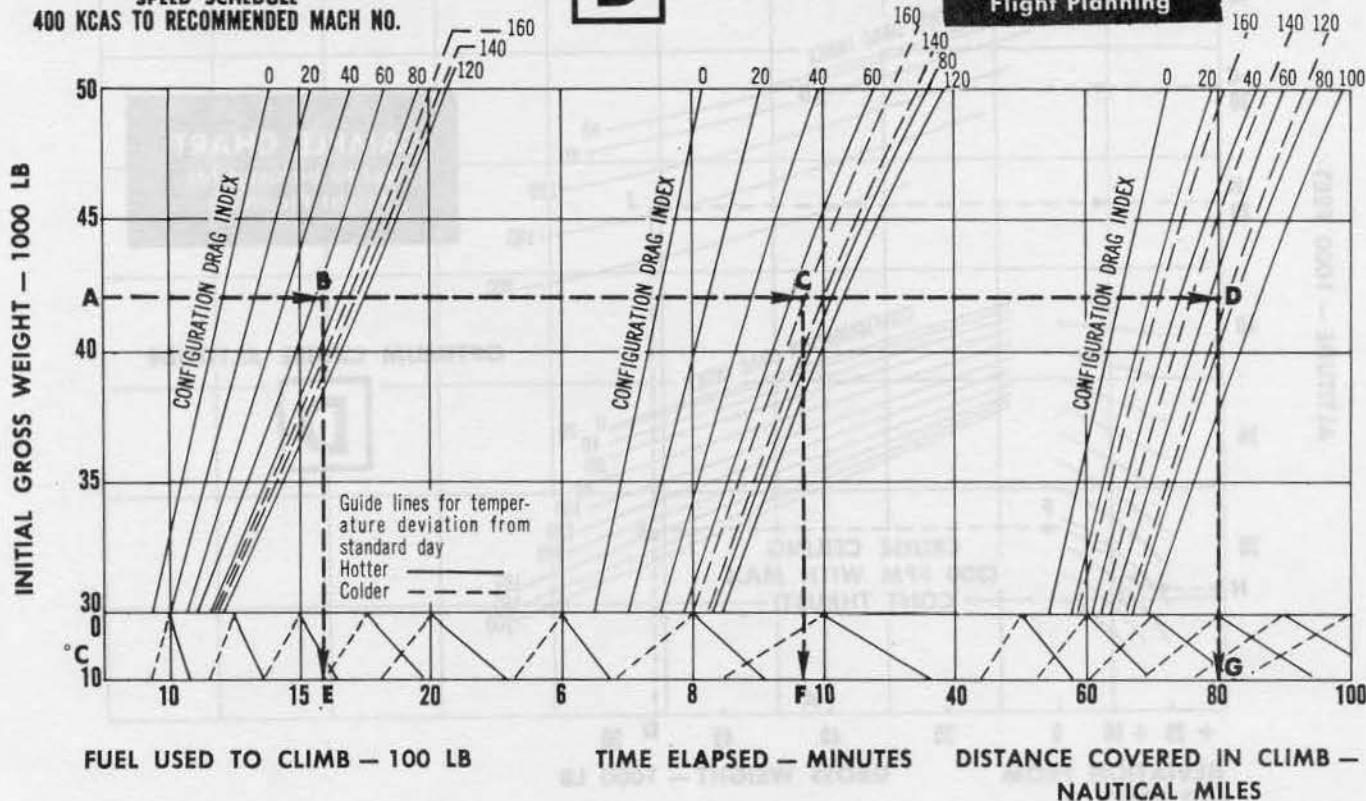
<i>Store</i>	<i>Location</i>	<i>Store Drag Number</i>
(1) 450 Gal. Tank	right inb'd	14
(1) 450 Gal. Tank	left inb'd	14
Configuration Drag Index =		28

2. Enter sample chart page A3-4 at a gross weight of 40,000 lb, (A)
3. Move horizontally to an altitude of 15,000 ft, (B)
4. Move vertically to a config. drag index of 28, (C)
5. Read a fuel used of 630 lb, (D) from the fuel scale on the left as the fuel used in climb from S.L. to 15,000 ft
6. Again enter sample chart page A3-4 at a gross weight of 40,000 lb, (A)
7. Move horizontally to an altitude of 25,000 ft, (E)
8. Move vertically to a config. drag index of 28, (F)
9. Read a fuel used of 1030 lb, (G) from the fuel scale on the left as the fuel used in climb from S.L. to 25,000 ft
10. Subtract the fuel used to climb to 15,000 ft (630 lb) from the fuel used to climb to 25,000 ft (1030 lb). The difference is the fuel used to climb from 15 000 ft to 25,000 ft ($1030 \text{ lb} - 630 \text{ lb} = 400 \text{ lb}$)
11. The time and distance to climb from 15,000 ft to 25,000 ft may be obtained by the same method from figure A3-1A.

**MILITARY THRUST CLIMB
TO CRUISE CLIMB ALTITUDE
SPEED SCHEDULE
400 KCAS TO RECOMMENDED MACH NO.**

D

SAMPLE CHART
Not to be used for
Flight Planning



CLIMB TO CRUISE-CLIMB ALTITUDE.

EXAMPLE III.

Conditions: Config: Clean + 650 Gal. Tank (center-line) + (2) LAU-3/A Rocket Launchers (inb'd) + (2) LAU-3/A Rocket Launchers (outb'd)

Initial Gross Weight: 42,000 lb

Initial Altitude: Sea Level

Final Altitude: Optimum Cruise (cruise-climb) altitude

Climb Thrust Setting: Military

Climb Speed Schedule: 400 KCAS to Recommended Mach Number

Ambient Temperature: Standard Day

Find: Fuel, time and distance in climb and level-off altitude.

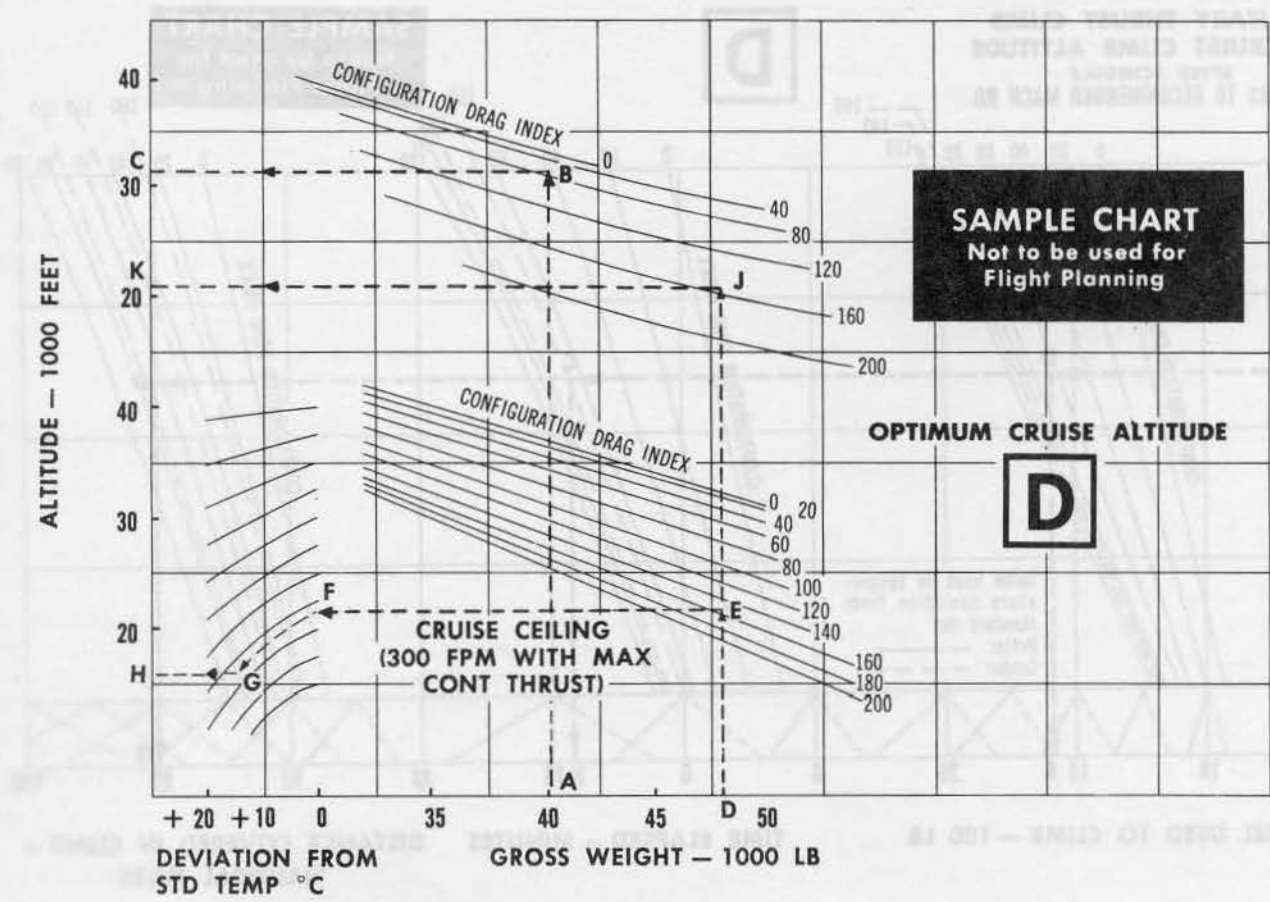
Solution:

1. Determine the configuration drag index from figure A1-5 by adding the various store drag numbers.

Store	Location	Store Drag Number
(1) 650 gal. tank	Centerline	24
(1) LAU-3/A	Right inboard	9
(1) LAU-3/A	Left inboard	9
(1) LAU-3/A	Right outb'd (in the presence of inb'd store)	13
(1) LAU-3/A	Left outb'd (in the presence of inb'd store)	13
		Configuration Drag Index = 68

2. Enter sample chart page A3-5 at Gross Weight = 42,000 lb, (A)

3. Move to the right to configuration drag index = 68, at (B), (C) and (D)



- 4. Drop vertically from (B), (C), and (D) to the fuel, time and distance scales, and read
Fuel used in climb = 1600 lb, (E)
Time elapsed in climb = 9.75 Min, (F)
Distance covered in climb = 80 NMi, (G)
- 5. Compute Gross Weight at end of climb
Initial Gross Weight = 42,000 lb
Fuel used in climb = 1,600 lb
Final Gross Weight = 40,400 lb
- 6. Enter sample chart page A3-6A at final Gross Weight = 40,400 lb, (A)
- 7. Move up to Configuration Drag Index = 68, (B).
- 8. Move to the left to the altitude scale and read
Level-Off Altitude = 31,400 ft, (C).

CLIMB TO CRUISE-CLIMB ALTITUDE

EXAMPLE IV.

Conditions: Config: Clean + (6) 750 lb bombs (centerline) + (8) 750 lb Bombs Inboard

Initial Gross Weight: 50,000 lb

Initial Altitude: Sea Level

Final Altitude: Optimum Cruise (cruise-climb) altitude

Climb Thrust Setting: Military

Climb Speed Schedule: 400 KCAS to Recommended Mach Number

Ambient Temperature: Average, Standard Day + 15° C

Find: Fuel, time and distance in Climb and level off altitude

Solution:

- 1. Determine the configuration Drag Index from figure A1-5 by adding the various store drag numbers.

Store	Location	Store Drag Numbers
(6) 750 lb Bombs	Centerline	75
(4) 750 lb Bombs	Right Inboard	40
(4) 750 lb Bombs	Left Inboard	40
Configuration Drag Index =		<u>155</u>

2. Since the Ambient Temperature is above Standard, the Cruise Climb Altitude must be checked against the Cruise Ceiling Altitude at the prevailing Ambient Temperature.
3. Estimate Weight at End of Climb
Initial Gross Weight = 50,000 lb
Estimated Fuel Used to Climb = 2000 lb
Estimated Gross Weight at End of Climb =
50,000 lb - 2000 = 48,000 lb.
4. Enter Sample Chart page A3-6 at Estimated Weight at End of Climb = 48,000 lb, D.
5. Move up to configuration drag index = 155 on the Cruise Ceiling curve, E.
6. Move horizontally to the left to 0°C deviation from Standard Temperature, F.

7. Follow the Temperature Guide Lines to read +15°C from Standard Temperature, G.
8. Move to the left to the Altitude Scale and read cruise ceiling altitude = 16,000 ft, (H).
9. From D, move up to configuration drag index = 155 on the Optimum Cruise Altitude Curve, J.
10. Move to the left to the Altitude Scale and read Optimum Cruise Altitude = 21,000 ft, K.
11. Since the Cruise ceiling (16,000 ft) is lower than the Optimum Cruise Altitude (21,000 ft) the sample curve on page A3-5 cannot be used.
12. Fuel to climb to the Cruise ceiling altitude of 16,000 ft is read from the proper thrust and speed schedule chart, as described in Example I. The Gross Weight at end of climb is then computed, and the cruise ceiling altitude re-determined using the newly computed Gross Weight. Fuel, Time and Distance to climb can then be read, as in Example I, from the appropriate climb charts.

Climb to Combat Ceiling is determined in the same manner, utilizing steps 3 and 12 above, and reading the required ceiling from figure A3-7 at the given conditions of Configuration and Ambient Temperature.

Model:	F-105D	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 FEB. 1963
fuel grade:	JP-4	data basis:	FLIGHT TEST



FUEL USED, DISTANCE COVERED AND TIME ELAPSED FROM BRAKE RELEASE TO CLIMB SPEED (400 KCAS)

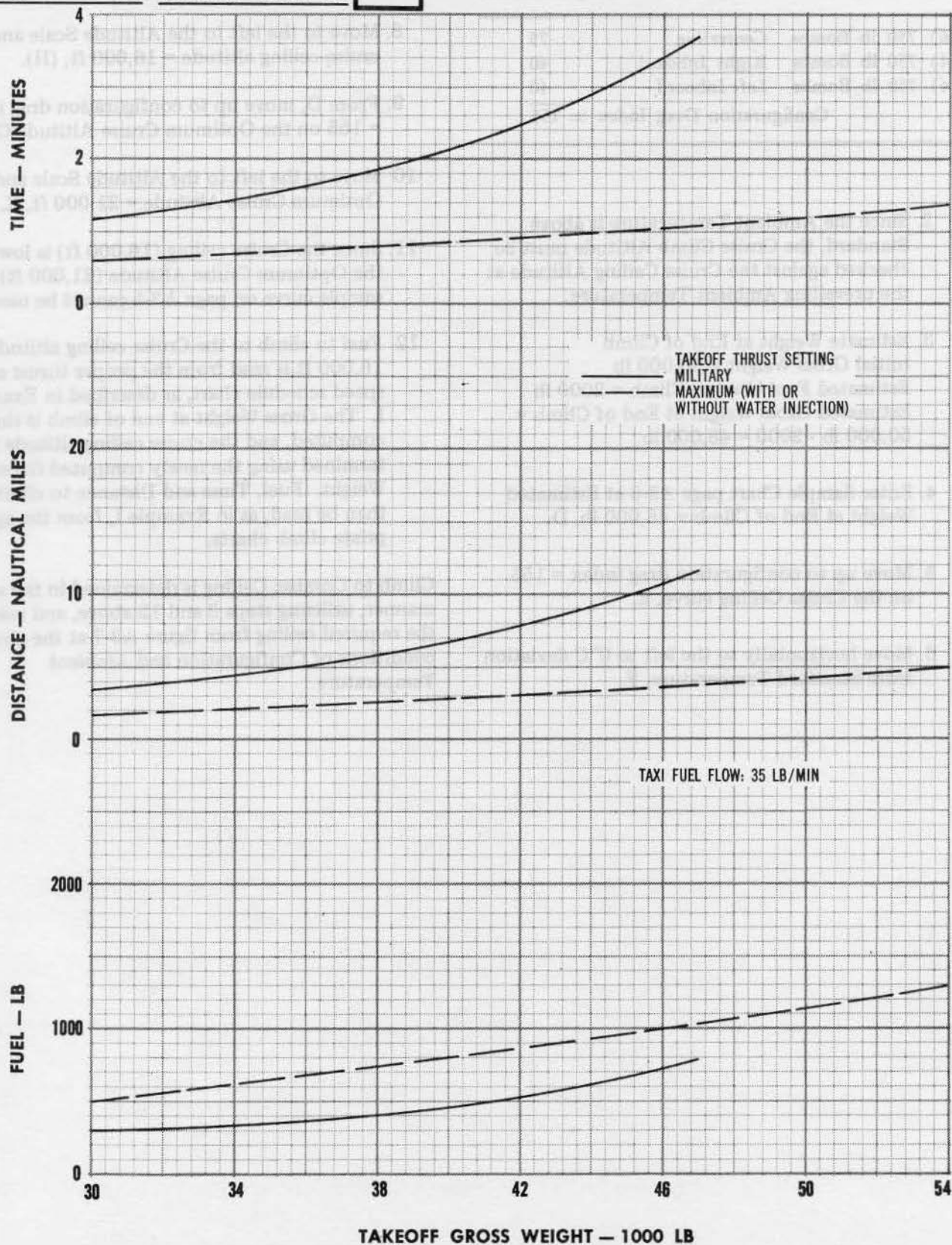


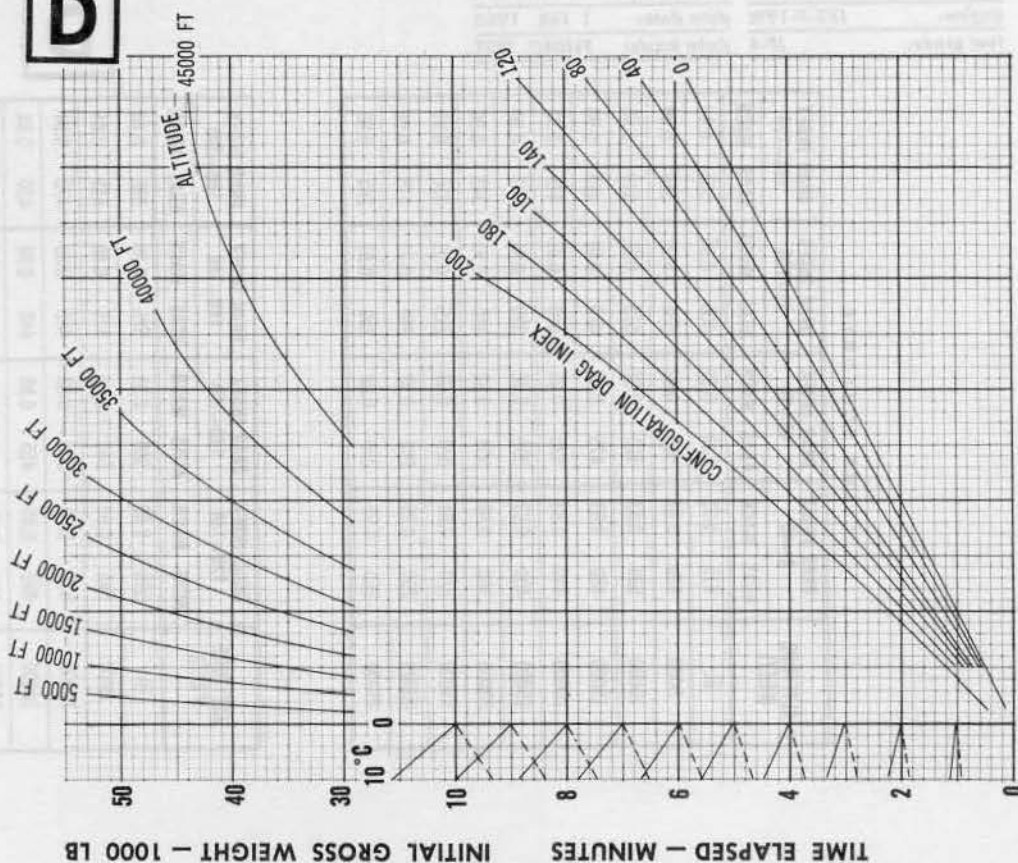
Figure A3-1

MAXIMUM THRUST CLIMB CONSTANT MACH NO.

D

Model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB. 1963
data basis: FLIGHT TEST

TIME ELAPSED



DISTANCE COVERED

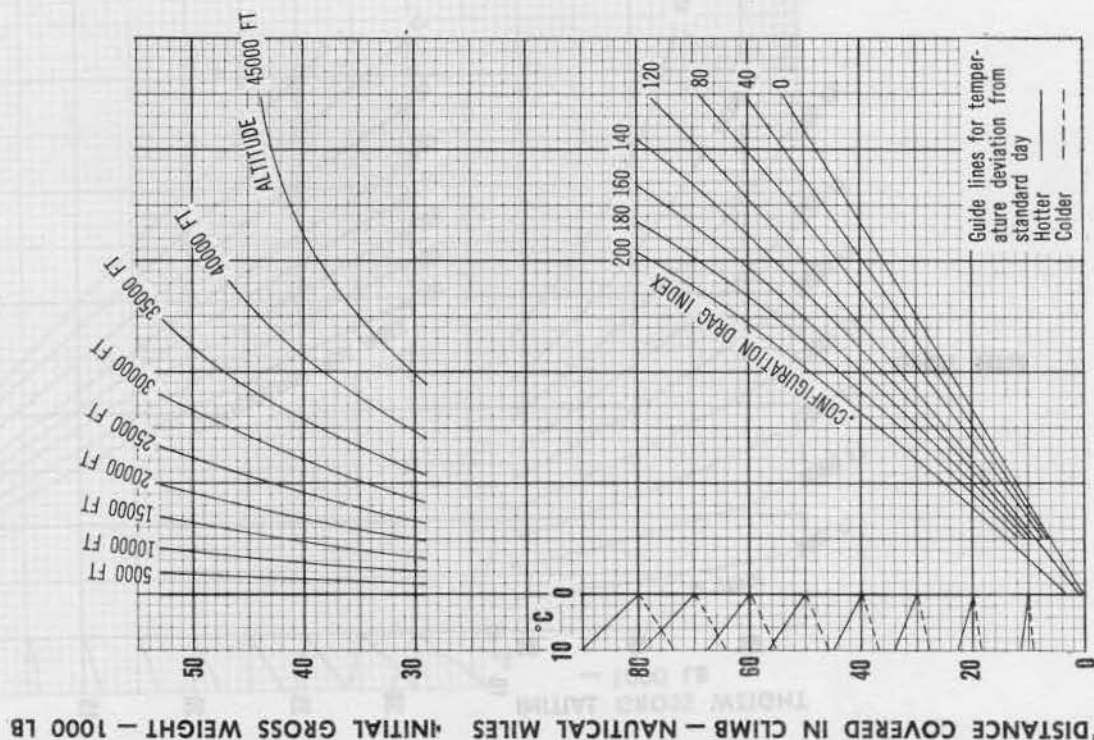


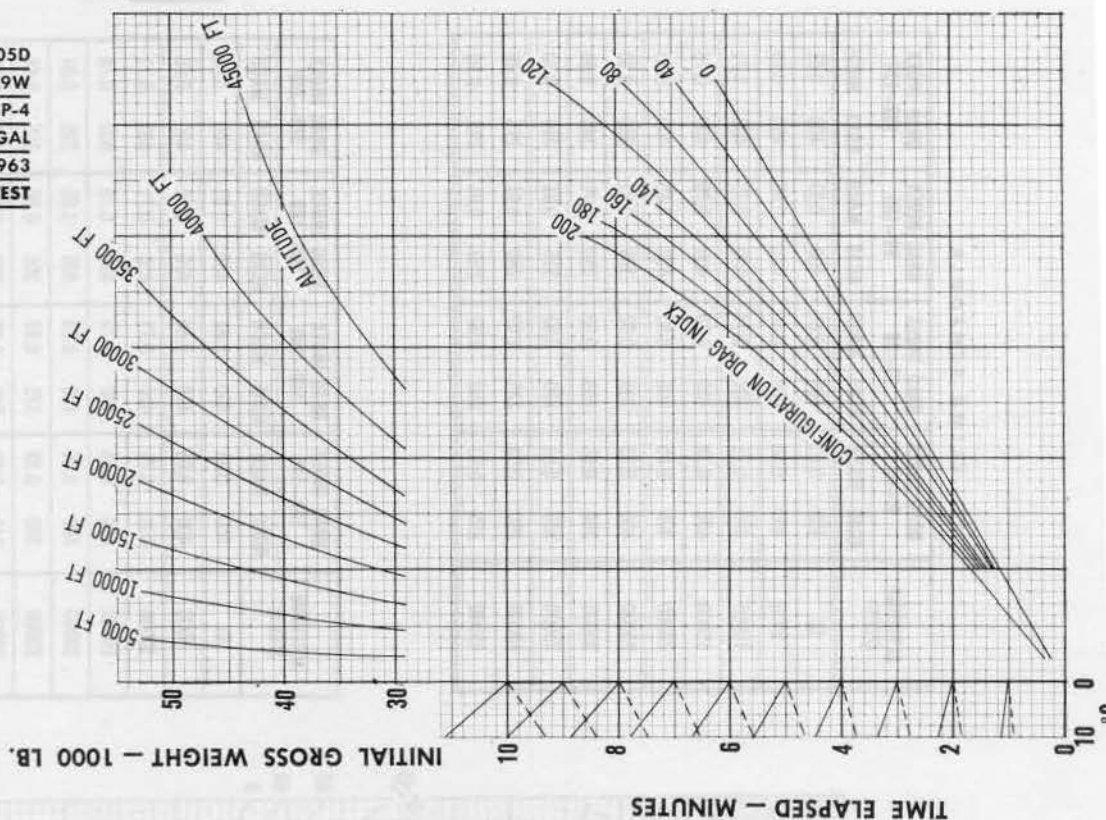
Figure A3-2 (Sheet 1 of 2)

**MAXIMUM THRUST CLIMB
SPEED SCHEDULE
400 KCAS TO RECOMMENDED MACH NO.**



Model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB. 1963
data basis: FLIGHT TEST

TIME ELAPSED



DISTANCE COVERED

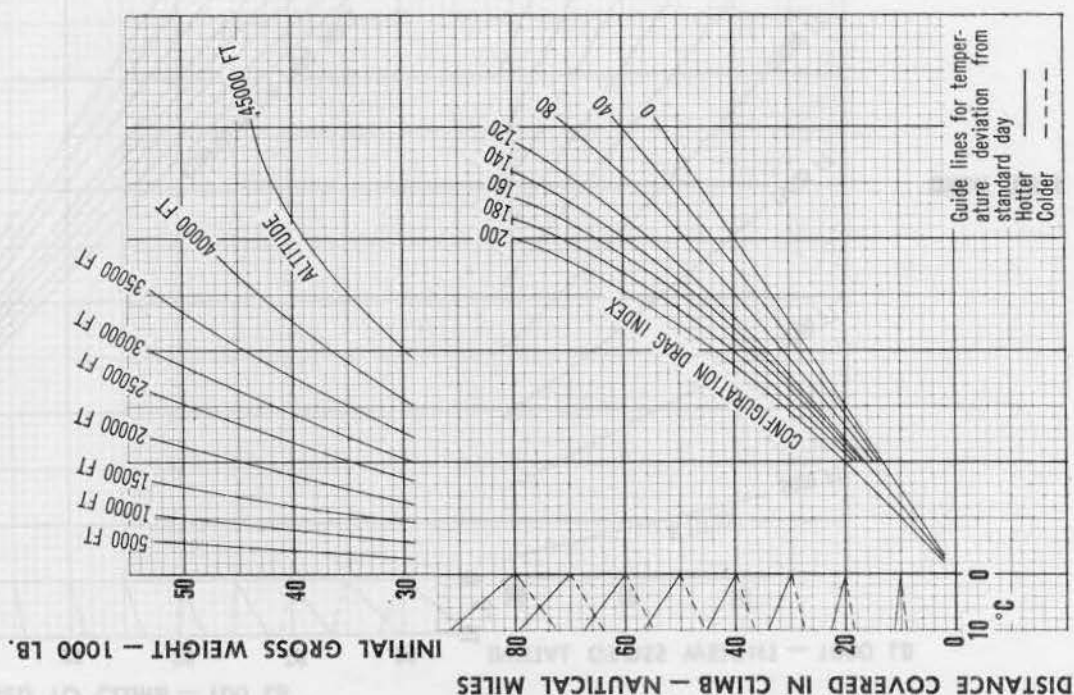


Figure A3-3 (Sheet 1 of 2)

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST



MAXIMUM THRUST CLIMB
 SPEED SCHEDULE
 400 KCAS TO RECOMMENDED MACH NO.

CLIMB SCHEDULE

ALTITUDE (FEET)	DRAG INDEX 0-40		DRAG INDEX 40-80		DRAG INDEX 80-100		DRAG INDEX 100-120	
	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH
SL	400	0.61	400	0.61	400	0.61	400	0.61
5000	400	0.66	400	0.66	400	0.66	400	0.66
10000	400	0.71	400	0.71	400	0.71	400	0.71
15000	400	0.78	400	0.78	400	0.78	400	0.78
20000	400	0.85	400	0.85	400	0.85	400	0.85
25000	400	0.93	395	0.92	390	0.91	385	0.90
30000	360	0.93	355	0.92	350	0.91	345	0.90
35000	320	0.93	320	0.92	315	0.91	310	0.90
40000	290	0.93	285	0.92	280	0.91	275	0.90
45000	255	0.93	250	0.92	250	0.91	245	0.90

ALTITUDE (FEET)	DRAG INDEX 120-140		DRAG INDEX 140-160		DRAG INDEX 160-180		DRAG INDEX 180-200	
	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH
SL	400	0.61	400	0.61	400	0.61	400	0.61
5000	400	0.66	400	0.66	400	0.66	400	0.66
10000	400	0.71	400	0.71	400	0.71	400	0.71
15000	400	0.78	400	0.78	400	0.78	400	0.78
20000	400	0.85	400	0.85	400	0.85	395	0.84
25000	380	0.89	375	0.88	365	0.86	355	0.84
30000	340	0.89	340	0.88	330	0.86	320	0.84
35000	305	0.89	300	0.88	295	0.86	285	0.84
40000	275	0.89	270	0.88	265	0.86	255	0.84
45000	245	0.89	240	0.88	235	0.86	225	0.84

NOTE:

1. Fuel allowance for engine start, taxi, takeoff and acceleration to climb speed is approximately 1500 LB.

FUEL USED

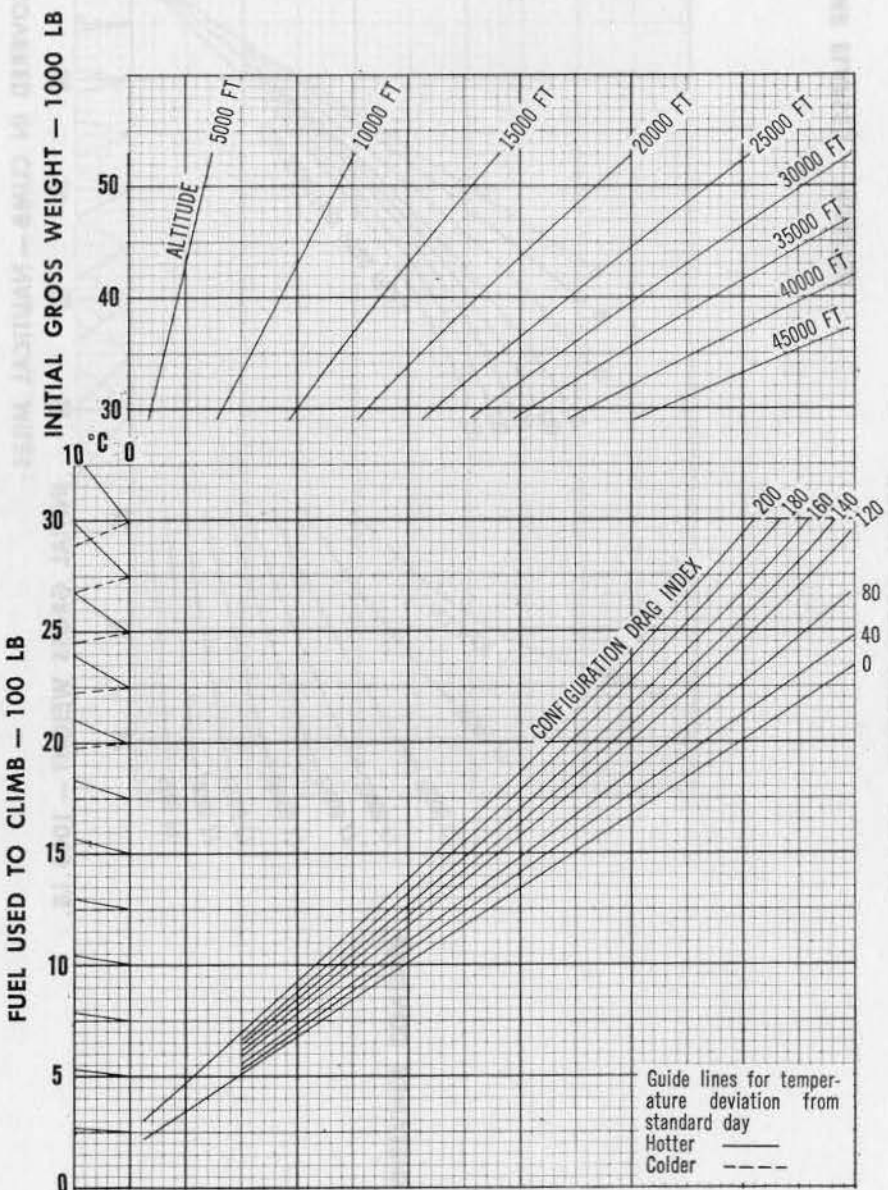


Figure A3-3 (Sheet 2 of 2)

**MILITARY THRUST CLIMB
CONSTANT MACH NO.**
D
TIME ELAPSED

Model:	F-105D
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 FEB. 1963
data basis:	FLIGHT TEST

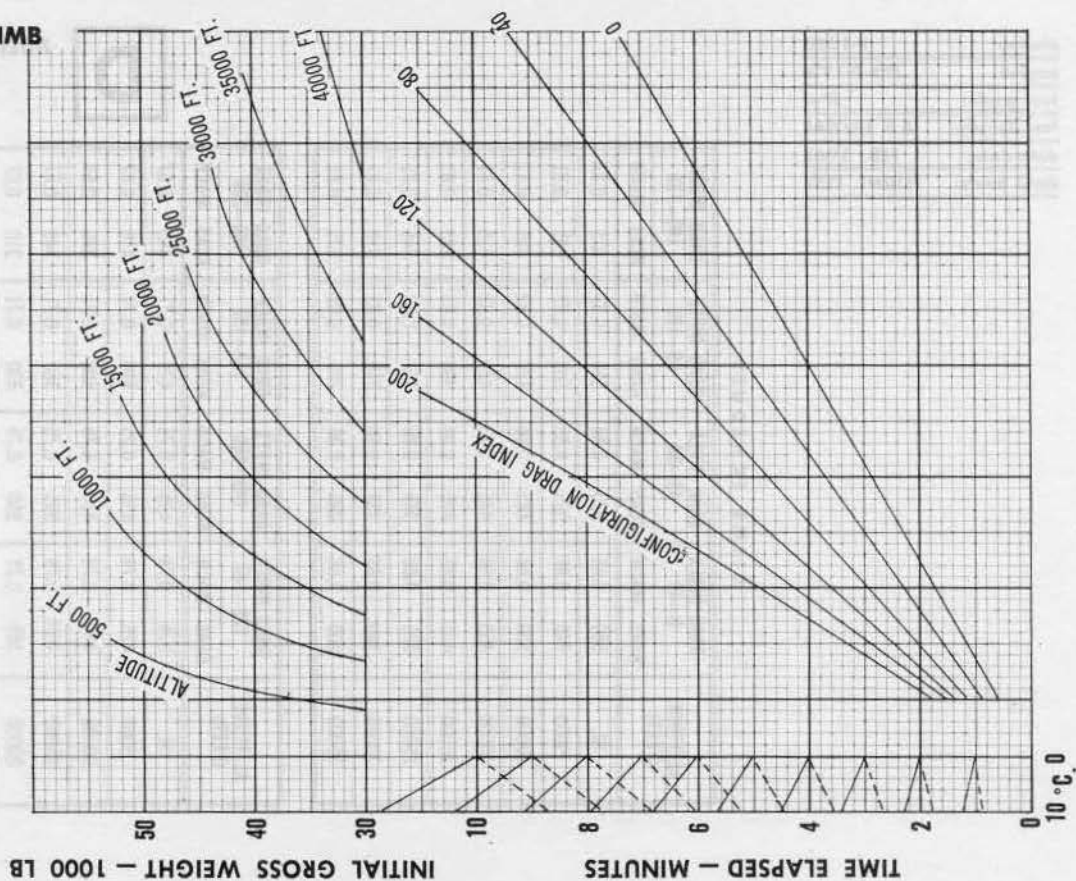
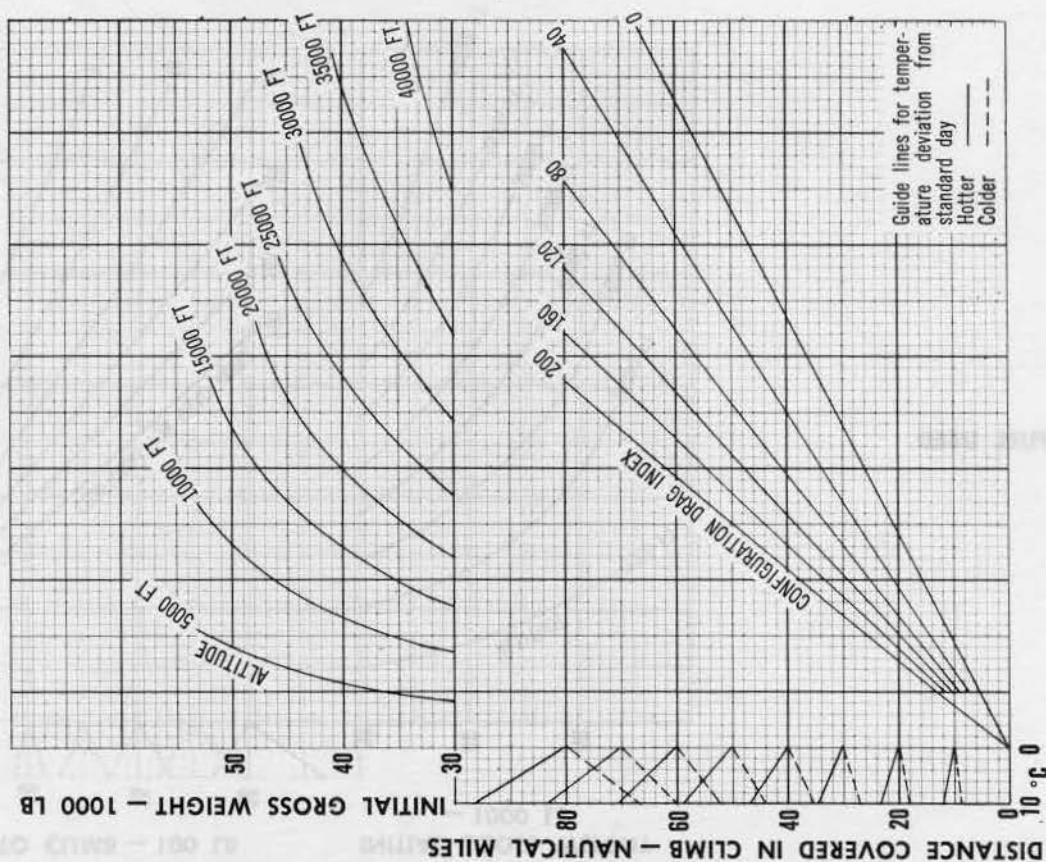

DISTANCE COVERED


Figure A3-4 (Sheet 1 of 2)

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

CLIMB SCHEDULE

ALTITUDE (FEET)	DRAG INDEX 0-40		DRAG INDEX 40-80		DRAG INDEX 80-100		DRAG INDEX 100-120	
	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH
SL	580	0.88	570	0.86	550	0.83	535	0.81
5000	540	0.88	525	0.86	505	0.83	495	0.81
10000	500	0.88	485	0.86	470	0.83	455	0.81
15000	455	0.88	445	0.86	425	0.83	415	0.81
20000	415	0.88	405	0.86	390	0.83	380	0.81
25000	375	0.88	365	0.86	350	0.83	345	0.81
30000	340	0.88	330	0.86	315	0.83	310	0.81
35000	300	0.88	295	0.86	285	0.83	275	0.81

ALTITUDE (FEET)	DRAG INDEX 120-140		DRAG INDEX 140-160		DRAG INDEX 160-180		DRAG INDEX 180-200	
	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH
SL	515	0.78	495	0.75	470	0.71	445	0.67
5000	475	0.78	455	0.75	430	0.71	410	0.67
10000	440	0.78	420	0.75	400	0.71	375	0.67
15000	400	0.78	385	0.75	360	0.71	340	0.67
20000	365	0.78	350	0.75	330	0.71	310	0.67
25000	330	0.78	315	0.75	295	0.71	280	0.67
30000	295	0.78	285	0.75	265	0.71	250	0.67
35000	265	0.78	255	0.75	240	0.71	225	0.67

NOTE:

- Fuel allowance for engine start, taxi, takeoff and acceleration to climb speed is approximately 1500 LB.



MILITARY THRUST CLIMB
 CONSTANT MACH NO.

FUEL USED

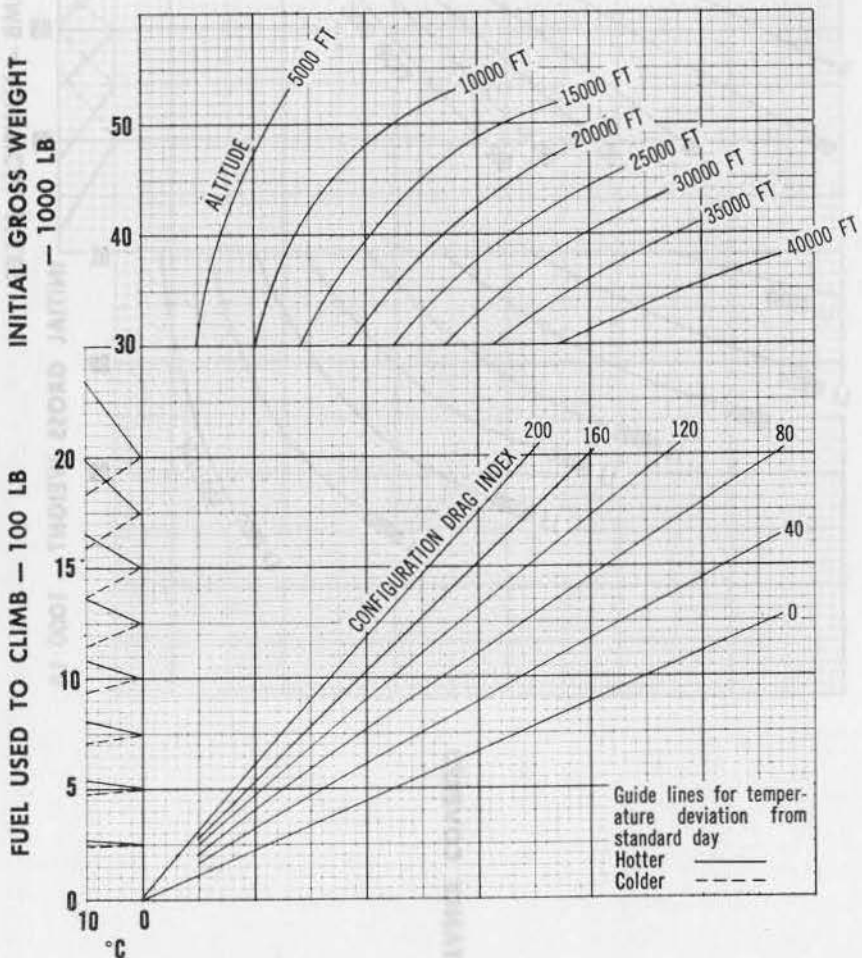
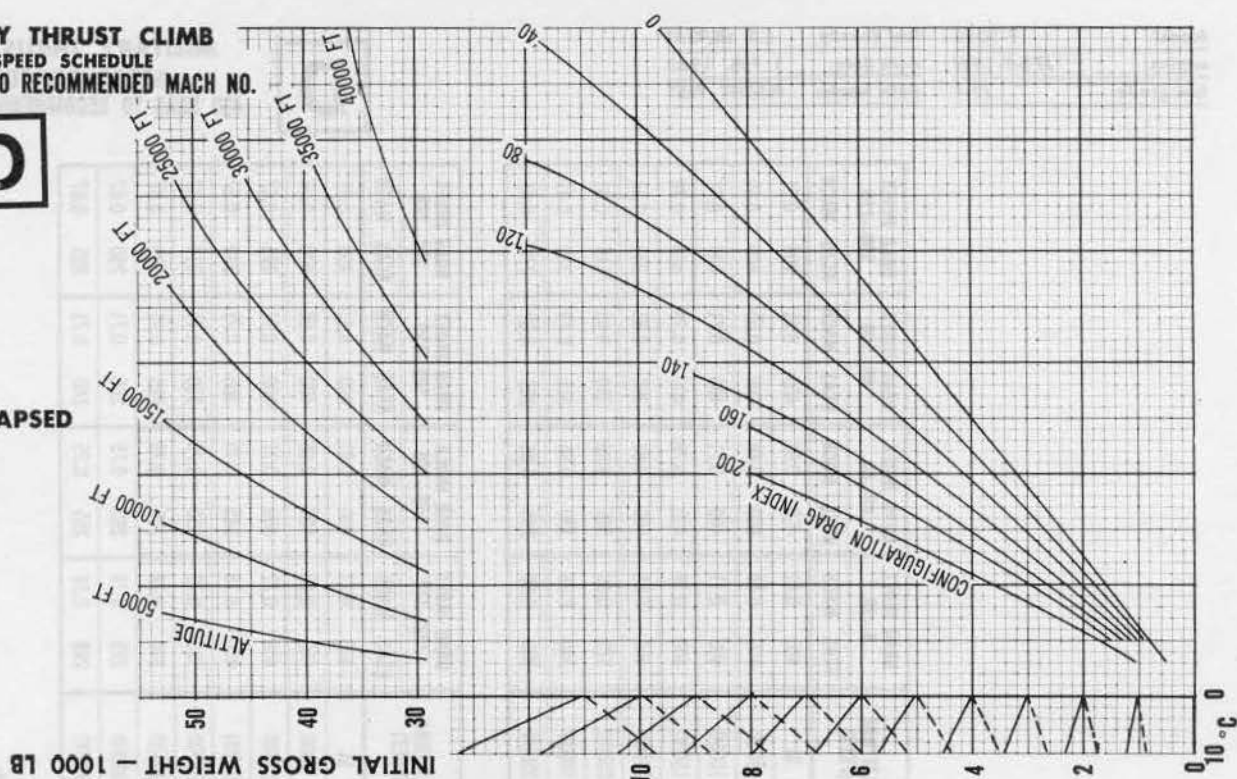


Figure A3-4 (Sheet 2 of 2)

MILITARY THRUST CLIMB **SPEED SCHEDULE** **400 KCAS TO RECOMMENDED MACH NO.**

D

TIME ELAPSED



Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

DISTANCE COVERED

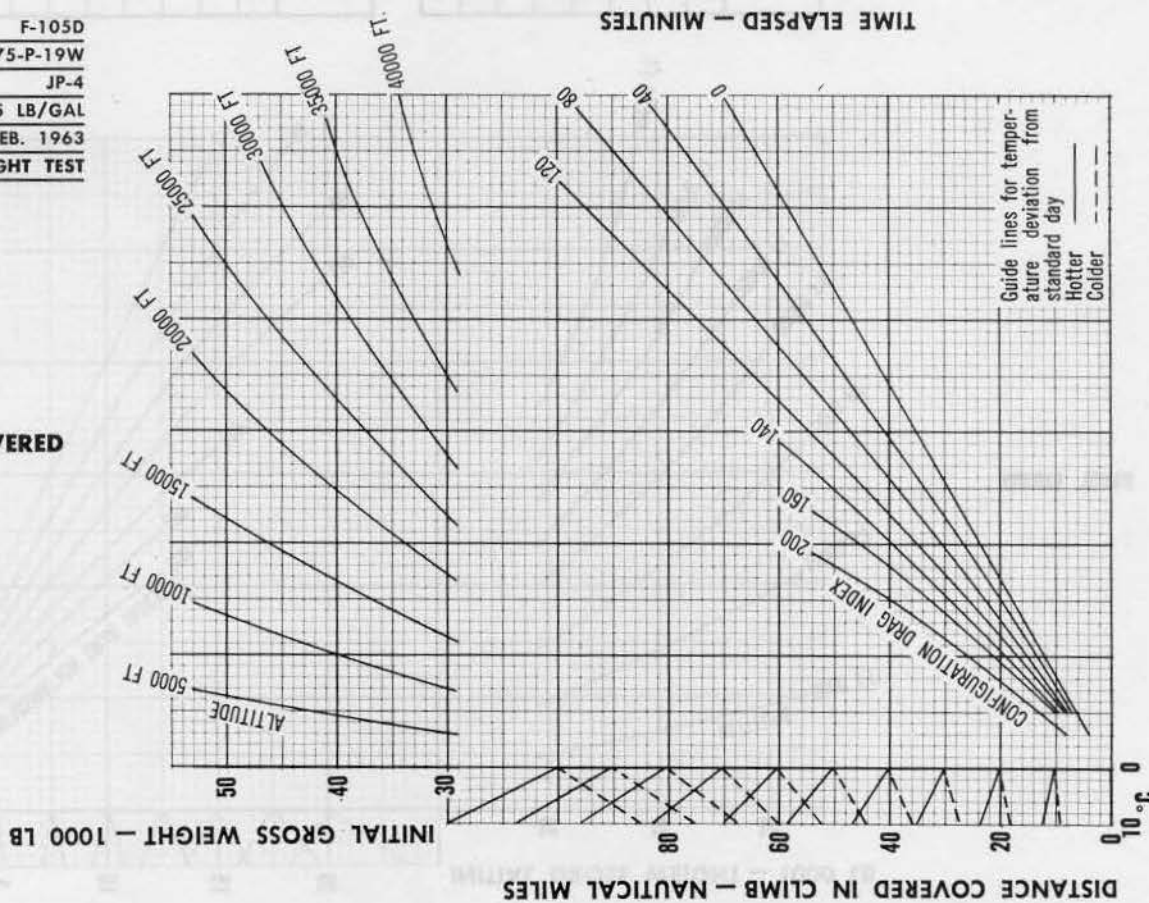


Figure A3-5 (Sheet 1 of 2)

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4

fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

ALTITUDE (FEET)	DRAG INDEX 0-40		DRAG INDEX 40-80		DRAG INDEX 80-100		DRAG INDEX 100-120	
	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH
SL	400	0.61	400	0.61	400	0.61	400	0.61
5000	400	0.66	400	0.66	400	0.66	400	0.66
10000	400	0.71	400	0.71	400	0.71	400	0.71
15000	400	0.78	400	0.78	400	0.78	400	0.78
20000	400	0.85	400	0.85	390	0.83	380	0.81
25000	375	0.88	365	0.86	350	0.83	345	0.81
30000	340	0.88	330	0.86	315	0.83	310	0.81
35000	300	0.88	295	0.86	285	0.83	275	0.81

ALTITUDE (FEET)	DRAG INDEX 120-140		DRAG INDEX 140-160		DRAG INDEX 160-180		DRAG INDEX 180-200	
	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH
SL	400	0.61	400	0.61	400	0.61	400	0.61
5000	400	0.66	400	0.66	400	0.66	400	0.66
10000	400	0.71	400	0.71	400	0.71	375	0.67
15000	400	0.78	385	0.75	360	0.71	340	0.67
20000	365	0.78	350	0.75	330	0.71	310	0.67
25000	330	0.78	315	0.75	295	0.71	280	0.67
30000	295	0.78	285	0.75	265	0.71	250	0.67
35000	265	0.78	255	0.75	240	0.71	225	0.67

NOTE:

1. Fuel allowance for engine start, taxi, takeoff and acceleration to climb speed is approximately 1500 LB.

D

MILITARY THRUST CLIMB
 SPEED SCHEDULE
 400 KCAS TO RECOMMENDED MACH NO.

FUEL USED

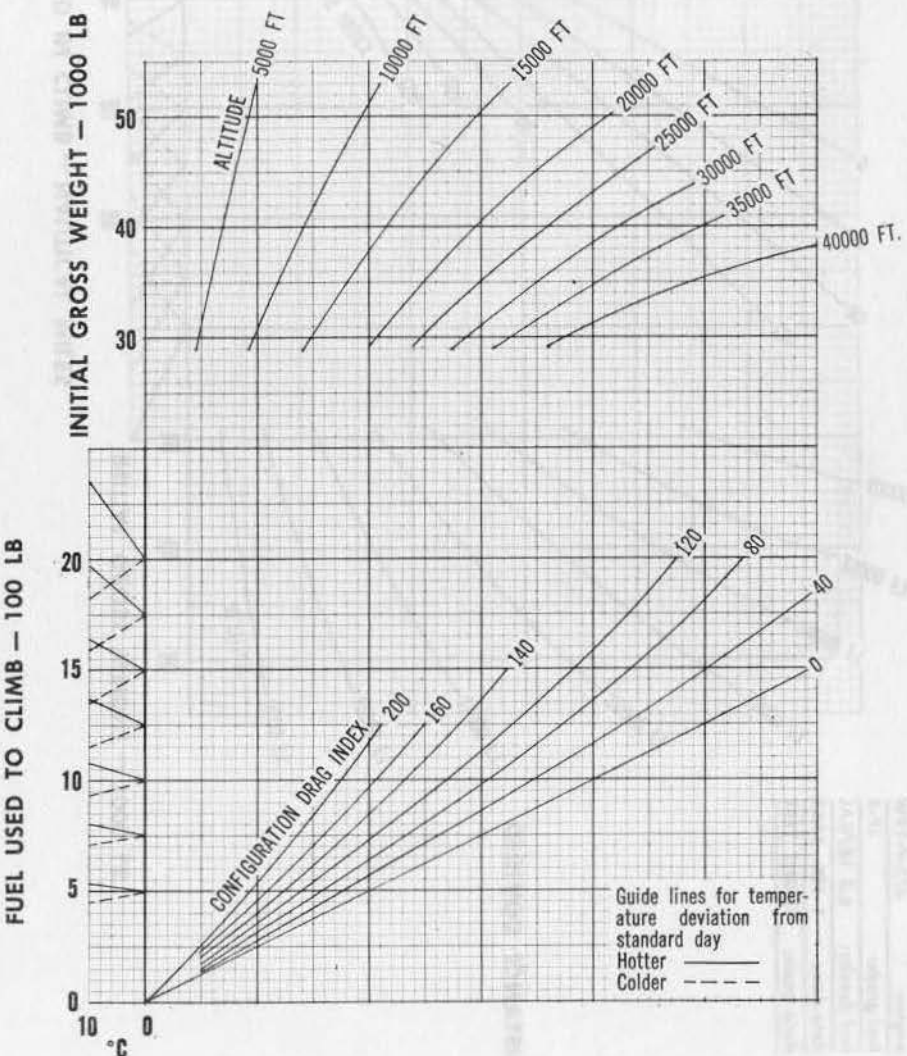


Figure A3-5 (Sheet 2 of 2)

MILITARY THRUST CLIMB TO CRUISE CLIMB ALTITUDE CONSTANT MACH NO.

Model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB. 1963
data basis: FLIGHT TEST



NOTE:

1. Fuel allowance for engine start, taxi, takeoff and acceleration to climb speed is approximately 1500 LB.

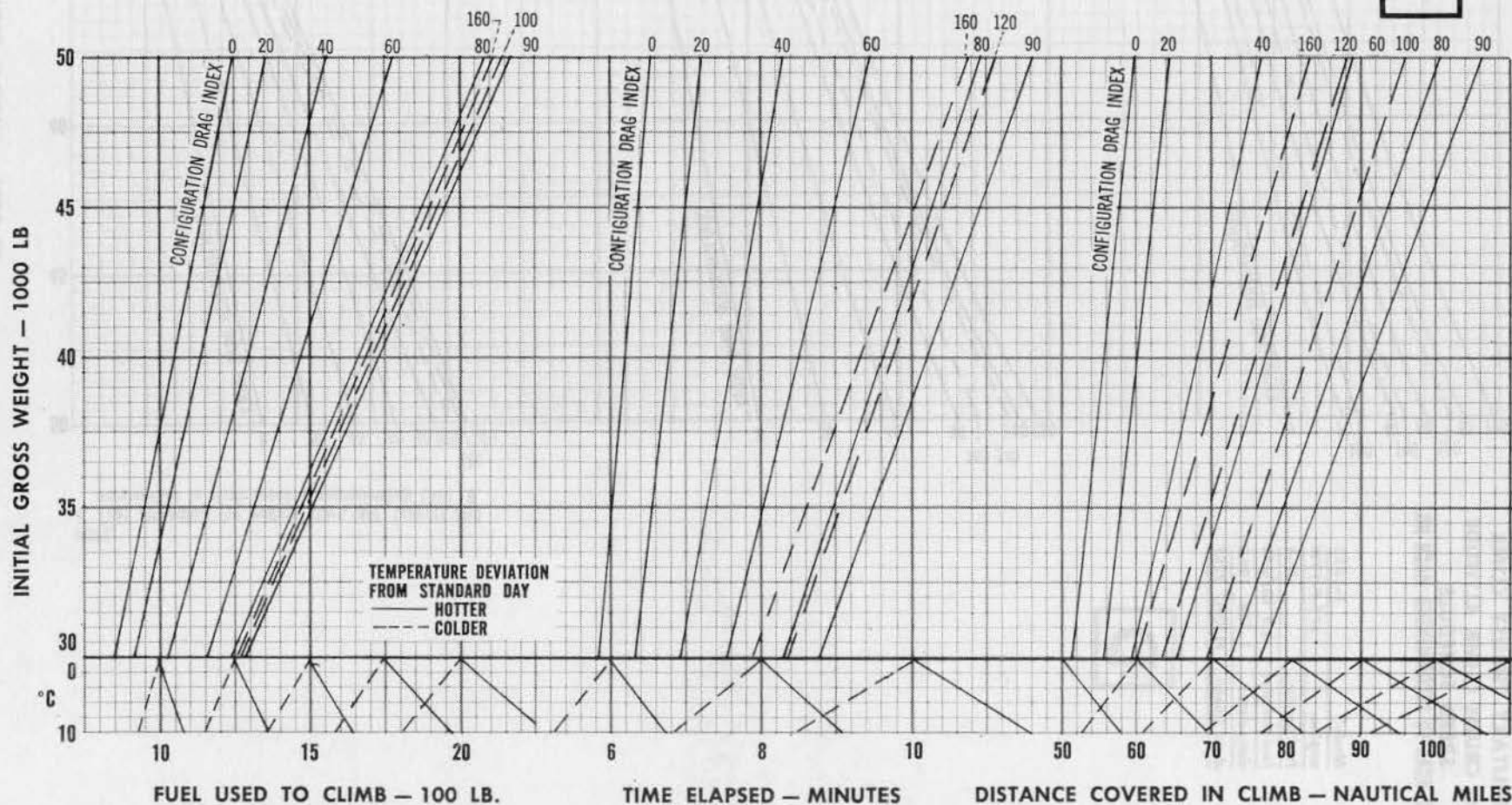


Figure A3-6

MILITARY THRUST CLIMB TO CRUISE CLIMB ALTITUDE SPEED SCHEDULE 400 KCAS TO RECOMMENDED MACH NO.

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

D

NOTE:

1. Fuel allowance for engine start, taxi, takeoff and acceleration to climb speed is approximately 1500 LB.

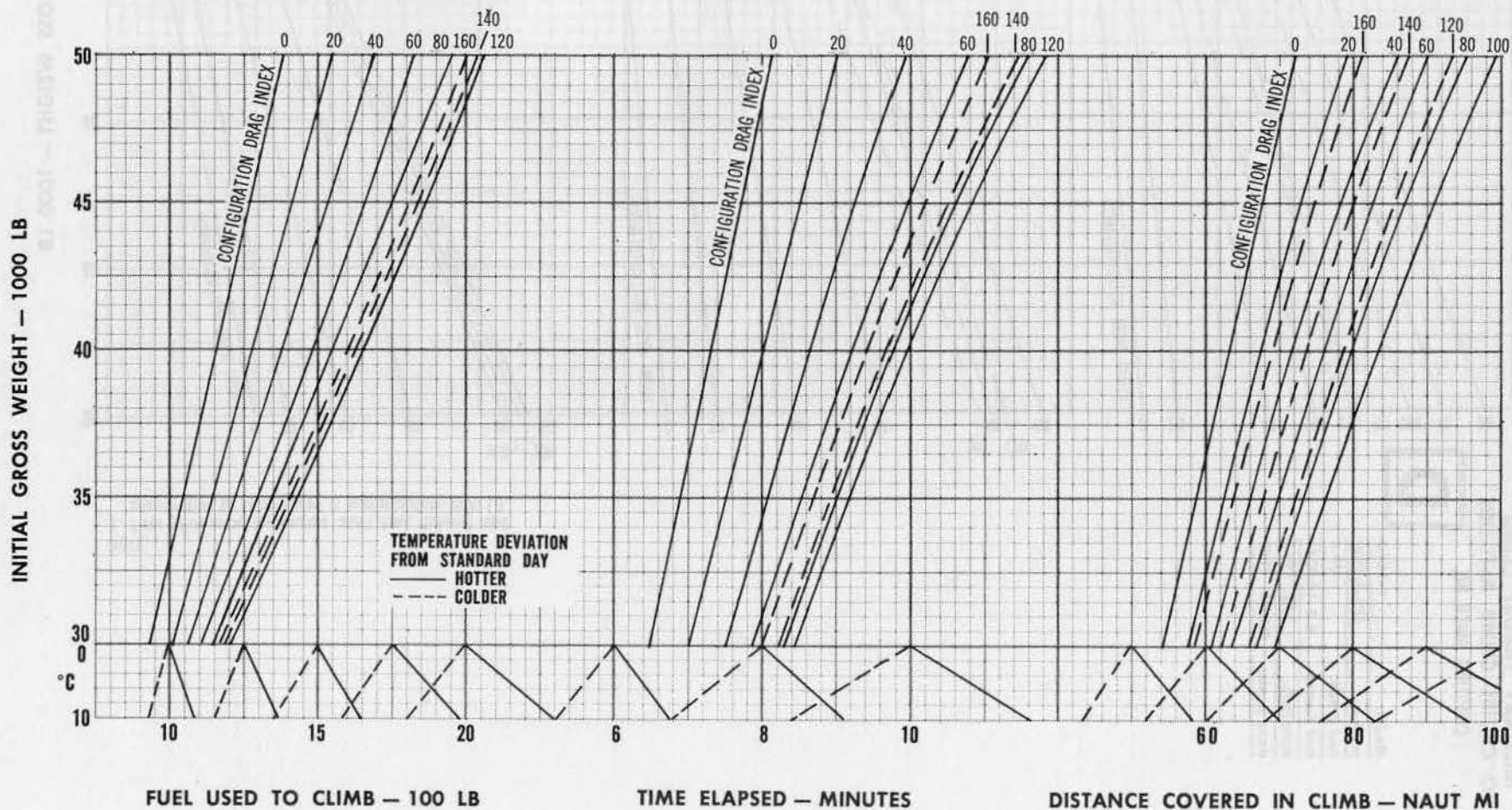


Figure A3-7

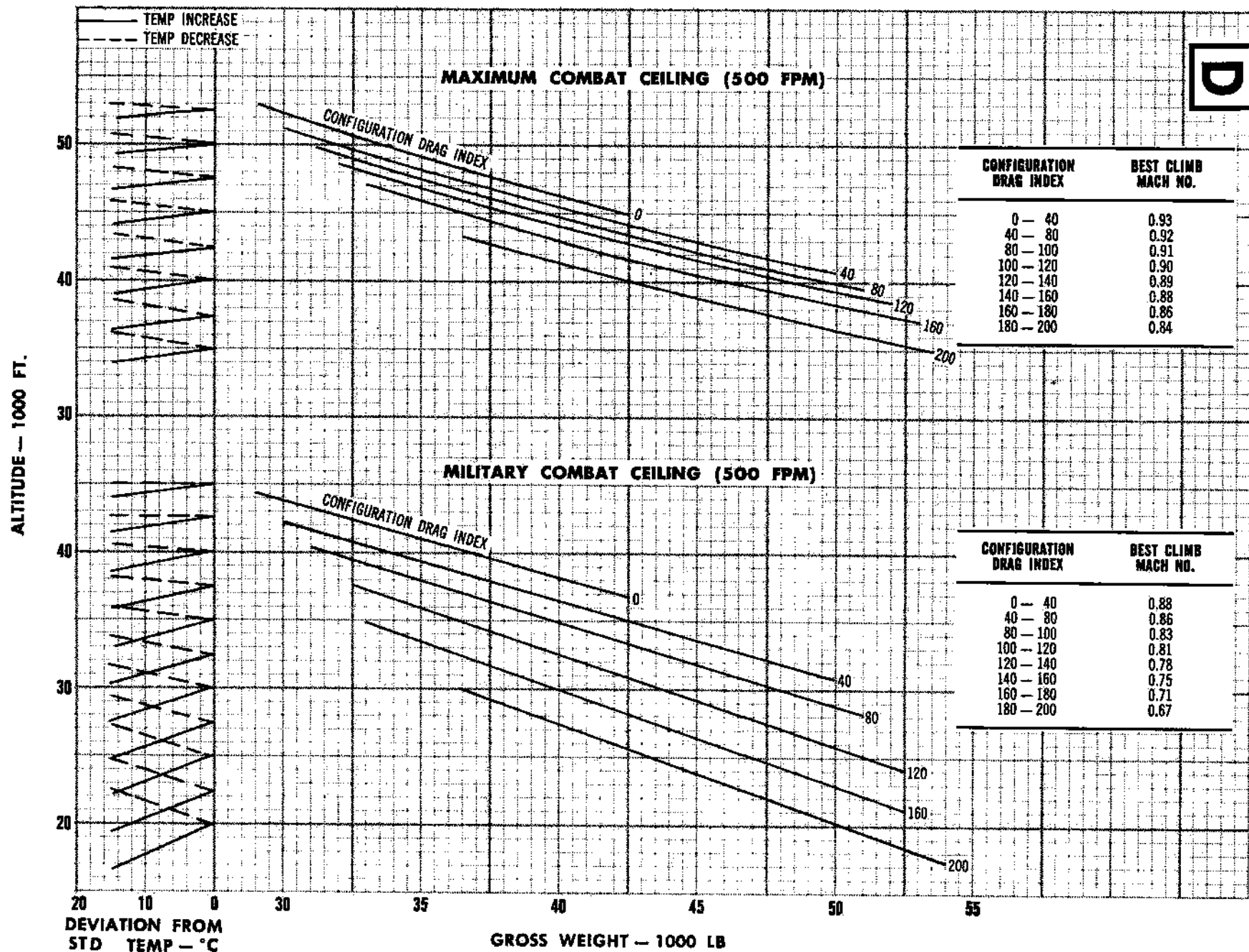
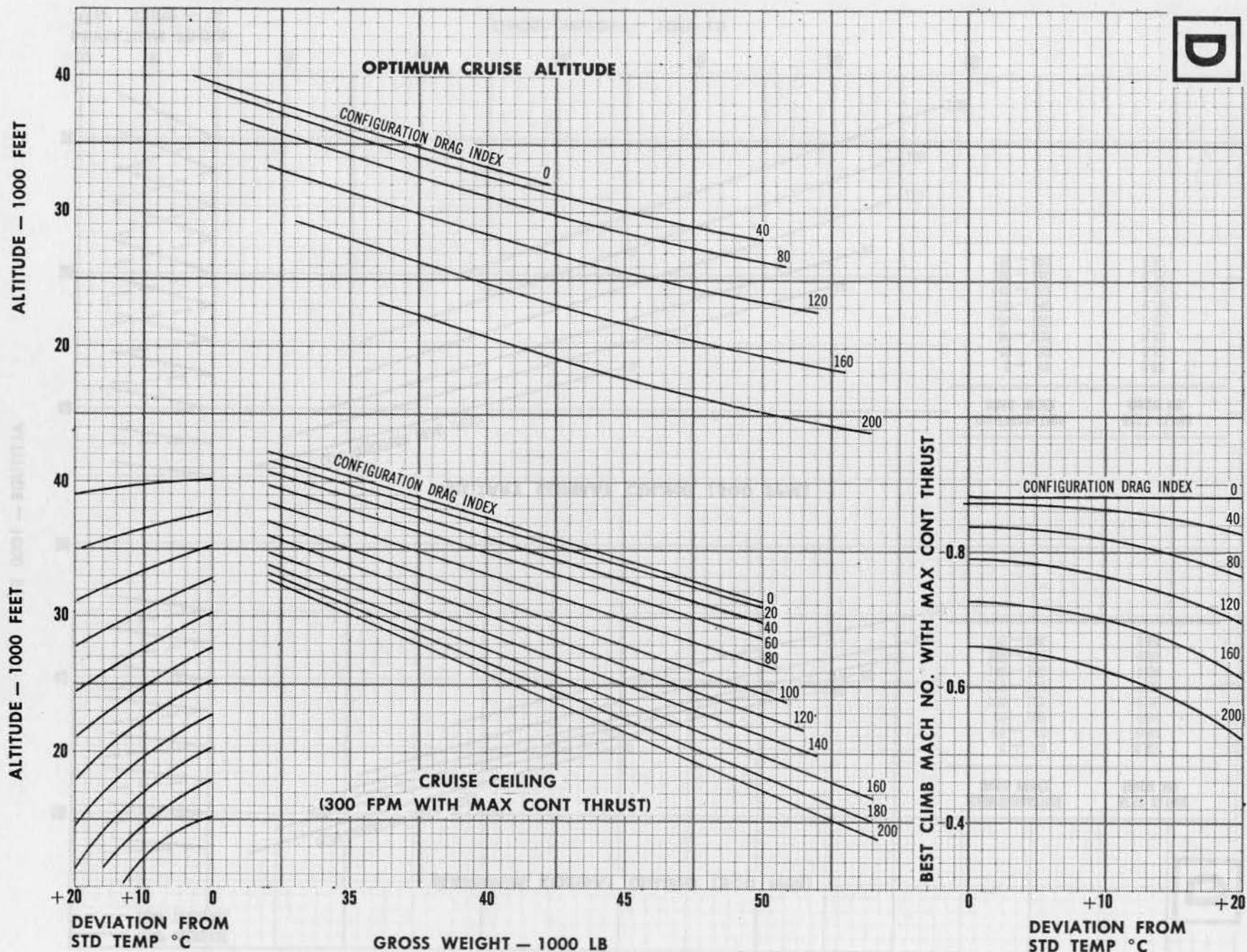


Figure A3-8 (Sheet 1 of 2)



A3-20

Figure A3-8 (Sheet 2 of 2)



MILITARY THRUST CLIMB
KC-135/F-105D
BUDDY CLIMB
SPEED SCHEDULE

D

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4

fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: *LIGHT TEST

ALTITUDE (FEET)	KCAS	MACH
SL	325	0.49
5000	325	0.54
10000	325	0.58
15000	325	0.64
20000	325	0.70
25000	325	0.77
30000	325	0.85

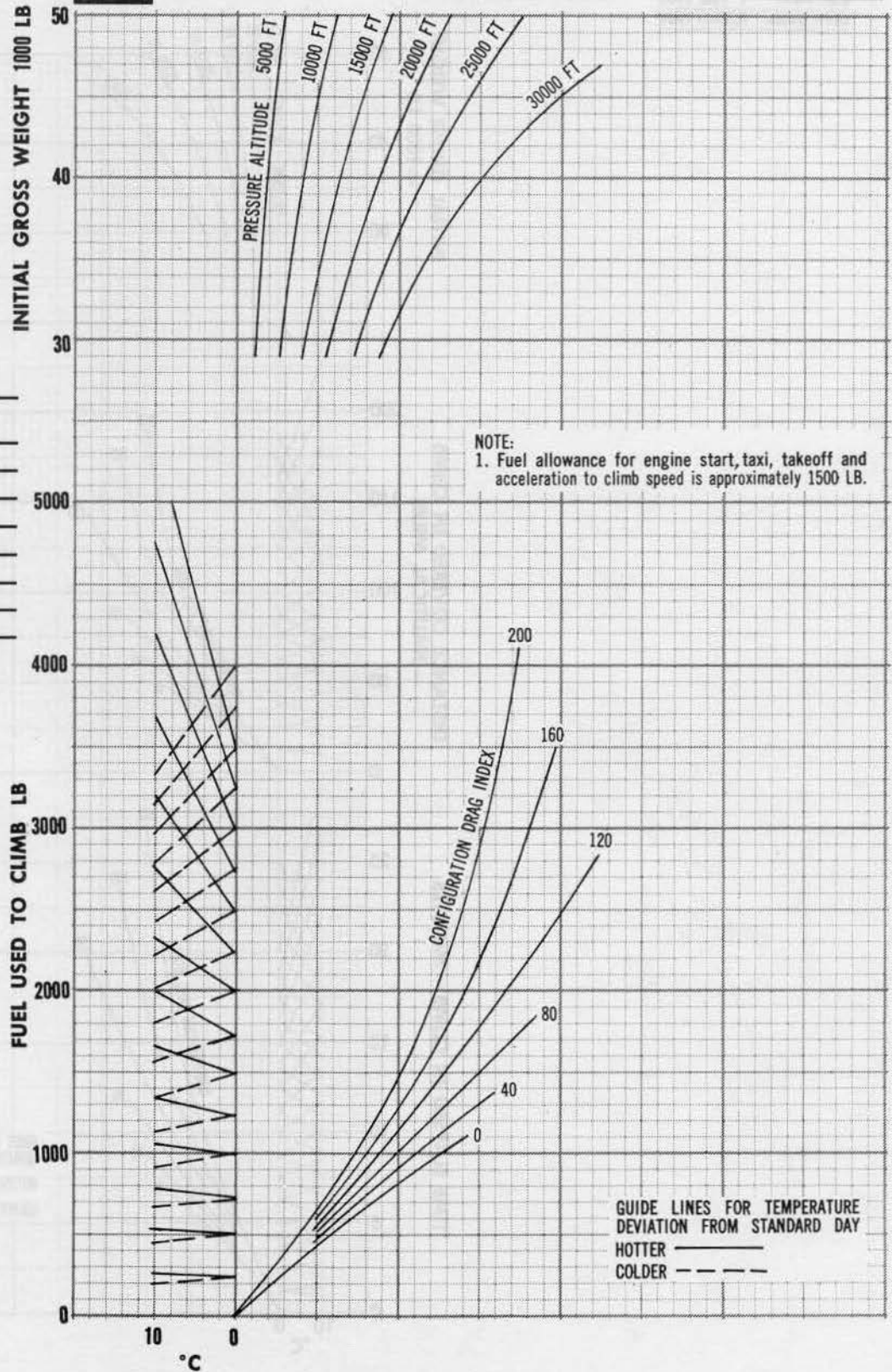


Figure A3-9 (Sheet 1 of 2)

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST



MILITARY THRUST CLIMB
KC135/F-105D BUDDY
CLIMB SPEED SCHEDULE

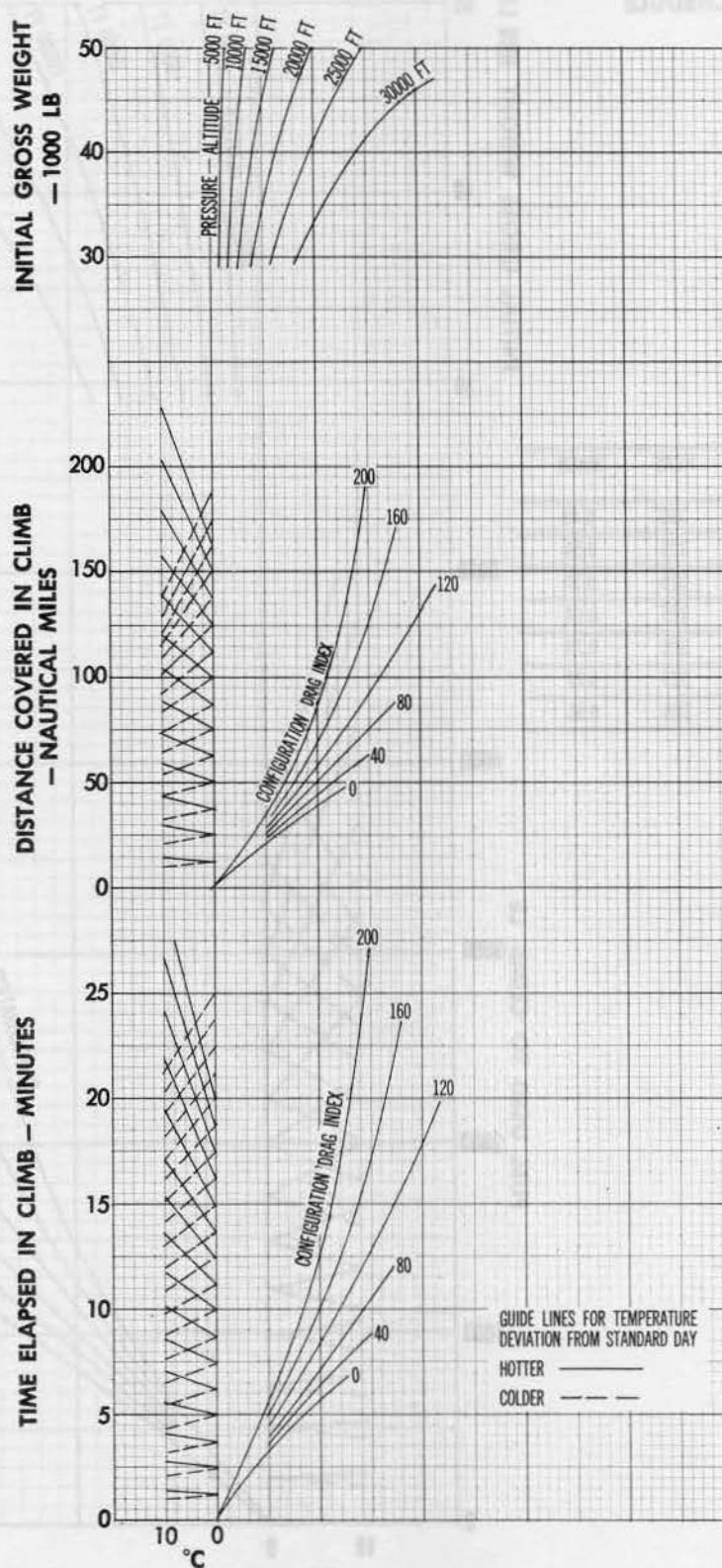


Figure A3-9 (Sheet 2 of 2)

PART 4 RANGE**TABLE OF CONTENTS**

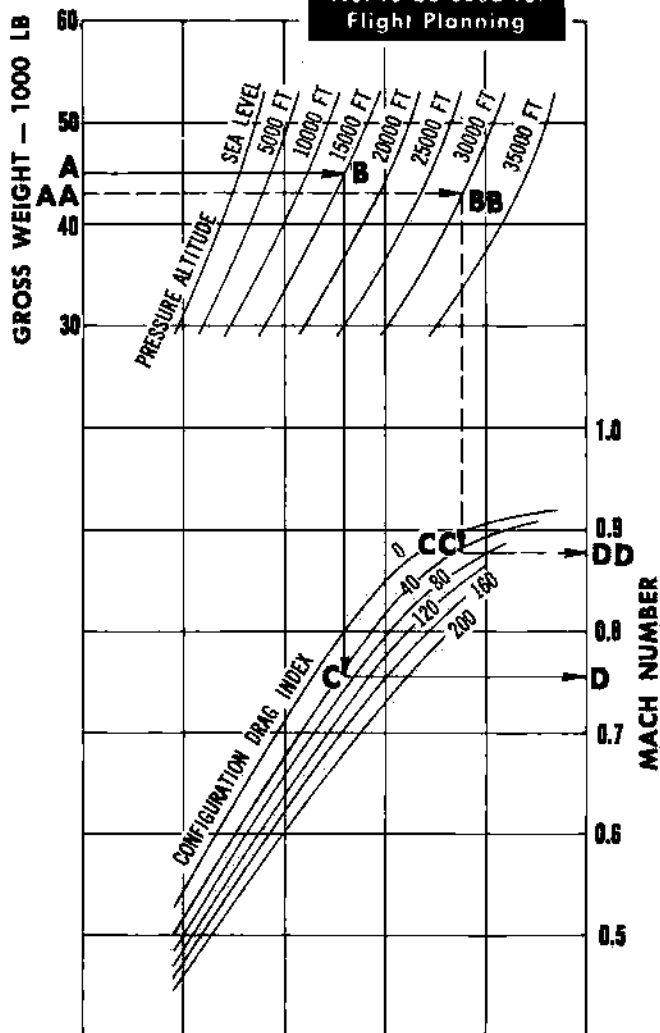
Constant Altitude Long Range Cruise Information	A4-2, A4-17
Cruise Climb Information	A4-7, A4-8, A4-20
Specific Range Charts	A4-11, A4-12, A4-22
Diversion Range Summary Table	A4-15, A4-26
Diversion Endurance Summary Table	A4-5, A4-30
Fuel Consumption in Minimum Extended A/B Range	A4-34

CONSTANT ALTITUDE
LONG RANGE CRUISE
MACH NO. AND TIME



SAMPLE CHART

Not to be used for
Flight Planning



CONSTANT ALTITUDE LONG RANGE CRUISE

From the constant altitude cruise curves the pilot can determine: 1) Speed for long range cruise, 2) Distance available for a given fuel quantity or fuel required to fly a given distance, and 3) Time elapsed during the cruise segment of (2) above, with wind and temperature conditions included.

EXAMPLE I

Conditions: Configuration: Clean + 650 gal tank (centerline) + (2) 450 gal tanks (inboard)
Initial Gross Weight: 47,000 lb
Cruise Altitude: 15,000 ft
Winds: Average 50 knot headwind
Ambient Temperature: 20°C warmer than standard

Find: Cruise Mach number, fuel required and time elapsed to fly 350 NMi Ground Distance.

Solution:

1. Determine the configuration drag index from figure A1-5 by adding the various store drag numbers.

Store	Location	Store Drag NO.
(1) 650 gal tank	Centerline	24
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb'd	14

Configuration Drag Index = 52

2. Read Standard Day temperature at 15,000 ft pressure altitude from Standard Atmosphere Table (figure A1-10) = -14.718°C.
Prevailing temperature = Standard + 20°C = -14.718° + 20° = +5.282°C.
3. Estimate Average Gross Weight
Initial Gross Weight = 47,000 lb
Estimated Fuel Used = 4000 lb
Estimated Final Gross Weight = 43,000 lb
Estimated Average Gross Weight = $\frac{47,000 + 43,000}{2} = 45,000$ lb
4. Enter sample chart page A4-2 estimated average gross weight = 45,000 (A). Move to the right and intercept pressure altitude = 15,000 ft at (B), and project down to the configuration drag index number = 52 (C). Move to

the right and read estimated constant altitude cruise Mach number = 0.754 (D).

5. Enter sample chart page A4-4 estimated cruise Mach number = 0.754 (E).

Parallel the guide lines from (E) until the ambient temperature (+5°C) is intercepted at (F). From (F) move to the right and intercept the 50 knot headwind line at (G). Continue from (G) to the zero wind - true airspeed reflector line (H). Drop down to the velocity scale and read TAS = 492 knots, (J). From (G) extend a vertical line upward to the required range line = 350 NMi, (K). From (K) move to the left and read estimated elapsed time = 47.5 minutes, (L).

6. Enter sample chart page A4-5 at estimated average gross weight = 45,000 lb, (M). Move horizontally to cruise altitude = 15,000 ft, (N). Drop vertically to configuration drag index number = 52, (P). Move horizontally to true airspeed = 492 knots, (Q), move up and intercept estimated elapsed time = 47.5 minutes, (R). Move to the left and read fuel used = 5050 lb, (S).

7. Revised Estimated Average Gross Weight

Initial Gross Weight = 47,000 lb

Fuel Used Reading = 5050 lb

Final Gross Weight = 41,950 lb

Average Gross

$$\text{Weight} = \frac{47,000 + 41,950}{2} = 44,475 \text{ lb}$$

8. Reworking steps 4, 5, and 6 with revised average gross weight = 44,475 lb, the respective readings are:

Mach Number	0.754
True Airspeed	492 knots
Elapsed Time	47.5 minutes
Fuel Used	5050 lb

Calibrated airspeed can be read from figure A4-1 at 0.75 Mach number and 15,000 ft as 386 KCAS.

EXAMPLE II

Conditions: Configuration: Clean + (2) 450 gal tanks (inboard) + (2) AGM-12B (outboard)

Initial Gross Weight: 44,000 lb

Cruise Altitude: 30,000 ft

Wind: Average 50 knot tailwind

Ambient Temperature: 10°C colder than standard

Find: Cruise Mach number, ground distance available and time elapsed in cruising with 2000 lb of fuel

Solution:

1. Determine the configuration drag index from figure A1-5 by adding the various store drag numbers.

	Store	Location	Store Drag NO.
(1)	450 gal tank	Left inb'd	14
(1)	450 gal tank	Right inb'd	14
(1)	AGM-12B	Left outb'd (in the presence of inb'd fuel tank)	13
(1)	AGM-12B	Right outb'd (in the presence of inb'd fuel tank)	13
Configuration Drag Index =			54

2. From figure A1-10 read standard day temperature at 30,000 ft pressure altitude = -44.436°C. Ambient temperature = -44.436 - 10 = -54.436°C.

3. Determine Average Gross Weight
Initial Gross Weight = 44,000 lb
Fuel Used in Cruise = 2000 lb
Final Gross Weight = 42,000 lb
Average Gross
Weight = $\frac{44,000 + 42,000}{2} = 43,000 \text{ lb}$

4. Enter sample chart page A4-2 at average gross weight = 43,000 lb, (AA), move to the right to cruise altitude = 30,000 ft, (BB), drop vertically to configuration drag index = 54 (CC), move to the right and read cruise Mach number = 0.877, (DD).

5. Enter sample chart page A4-4 at cruise Mach number = 0.877, (EE). Parallel the guide lines from (EE) until the ambient temperature (-54°C) is intercepted at (FF). From (FF) move to the right and intercept the zero wind;

true airspeed reflector line at (GG). Drop down to the velocity scale and read true airspeed = 502 knots, (HH). Continue from (GG) horizontally to the 50 knot tail wind line, (JJ). From (JJ) project a vertical line into the time — ground distance plot.

6. Enter sample chart page A4-5 at average gross weight = 43,000 lb, (KK). Move horizontally to cruise altitude = 30,000 ft,

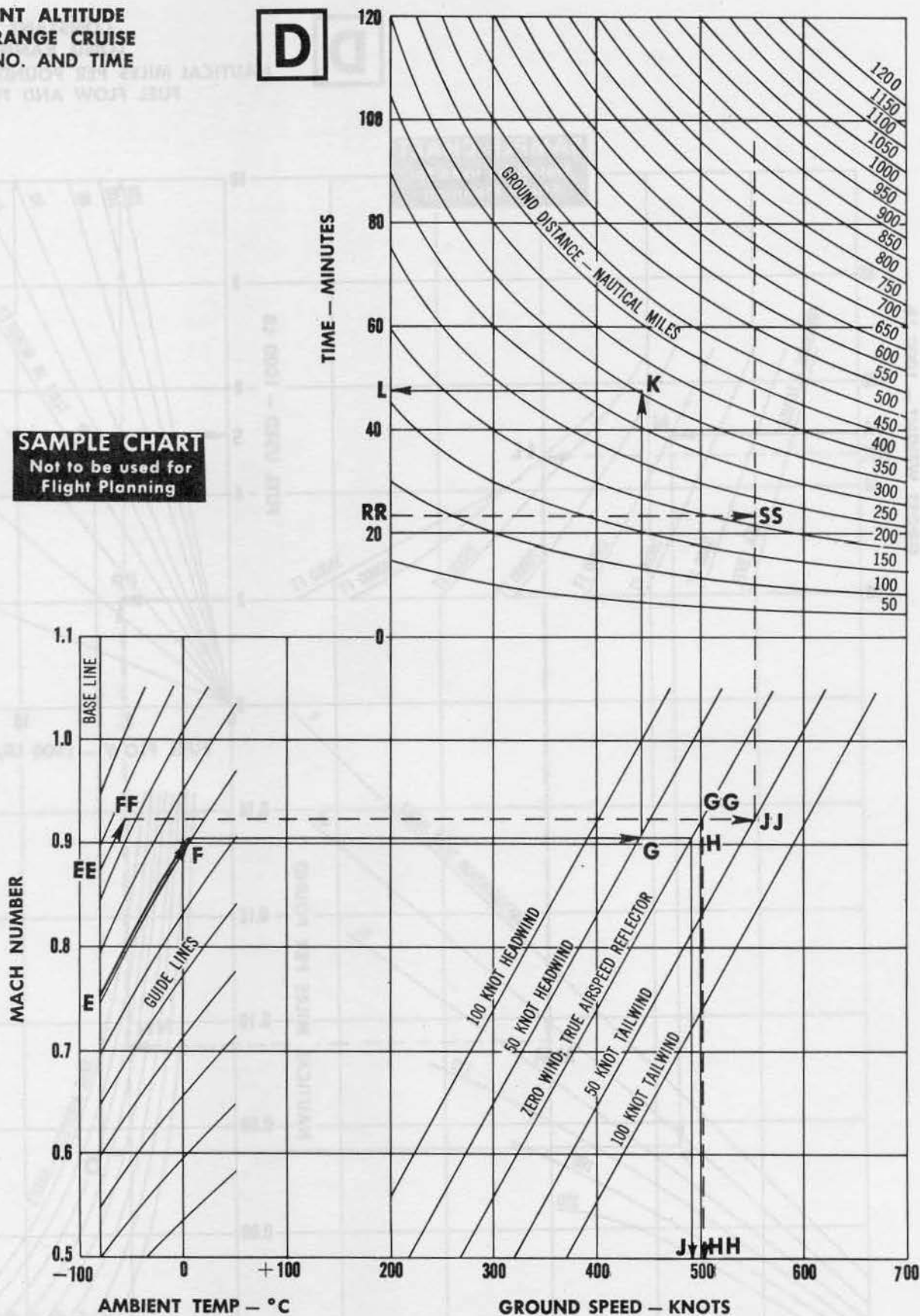
(LL). Drop down to configuration Drag Index number = 54 (MM). From (MM) move horizontally across to true airspeed = 502 knots, (NN). Move up to fuel used = 2000 lb and read time elapsed = 23.5 minutes at (PP).

7. Re-enter sample chart page A4-4 at elapsed time = 23.5 minutes (RR). Move to the right and intercept line from (JJ) and read ground distance = 21.5 NMi, (SS).

**CONSTANT ALTITUDE
LONG RANGE CRUISE
MACH NO. AND TIME**

D

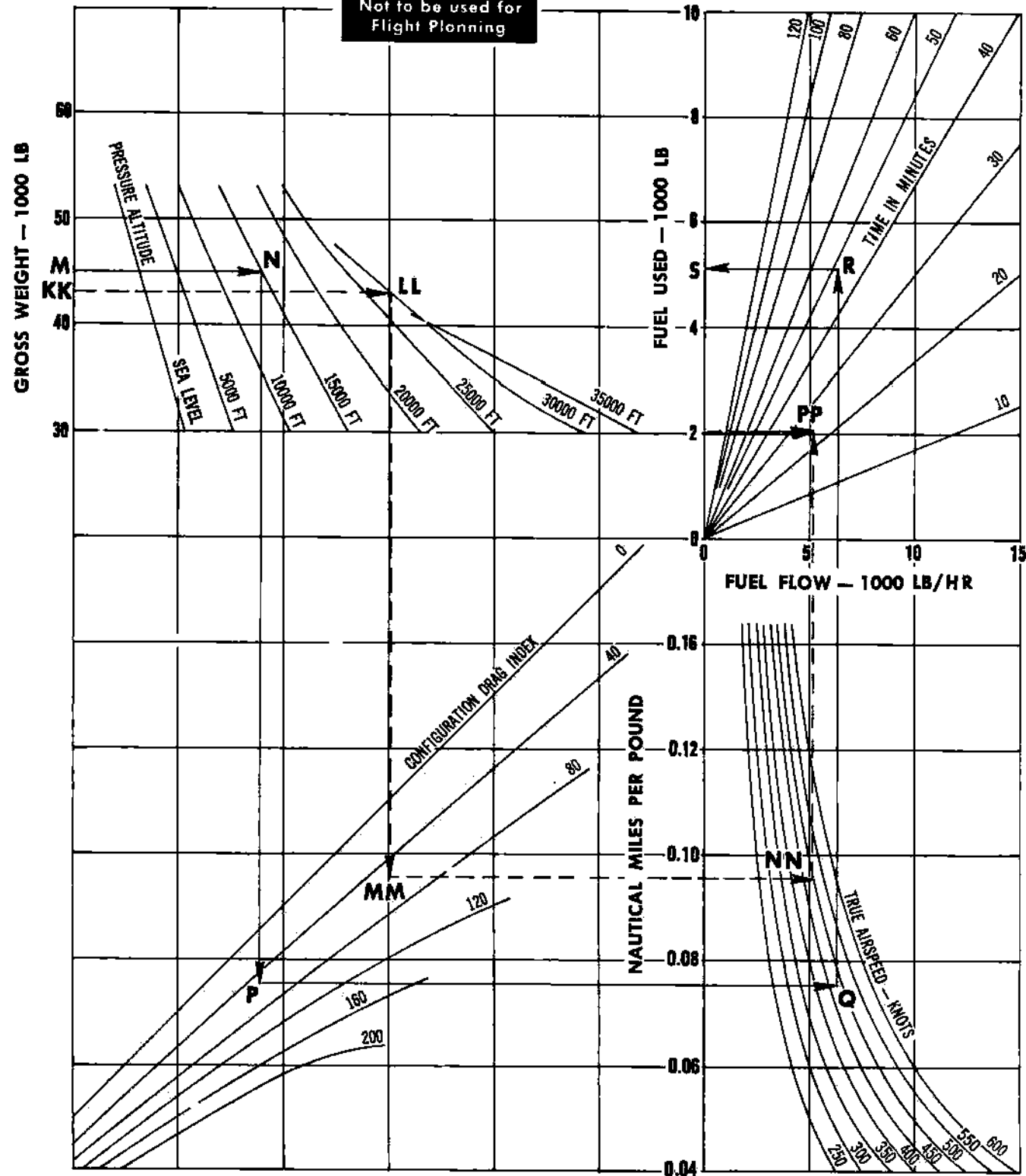
SAMPLE CHART
Not to be used for
Flight Planning





**CONSTANT ALTITUDE
LONG RANGE CRUISE
NAUTICAL MILES PER POUND OF FUEL
FUEL FLOW AND FUEL USED**

SAMPLE CHART
Not to be used for
Flight Planning

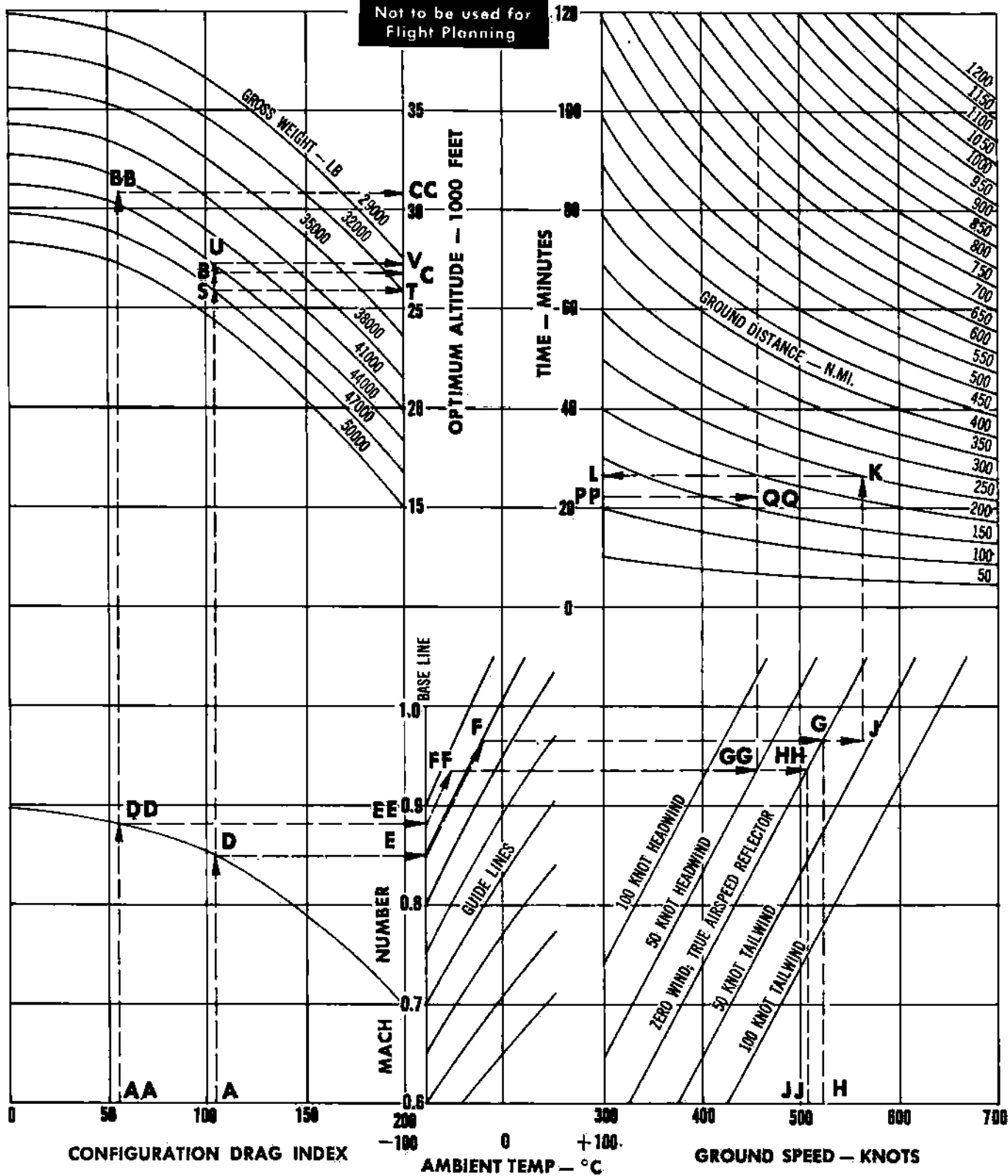


CRUISE CLIMB PERFORMANCE
CRUISE ALTITUDE, MACH NUMBER AND TIME



SAMPLE CHART

Not to be used for
Flight Planning



CRUISE CLIMB

From the cruise-climb curves the pilot can determine:

- 1) Mach number for long range cruise, 2) Altitudes for long range cruise, 3) Fuel required to fly a given distance, or distance covered for a given fuel quantity, 4) Time elapsed during cruise segment of (3) above, with wind and temperature corrections as applicable.

EXAMPLE I

Conditions: Configuration: Clean + (6) 750 lb bombs (centerline) + (2) 450 gal tanks (inboard)

Initial Gross Weight: 47,000 lb

Winds: Average 40 knot tailwind

Ambient Temperature: 15°C warmer than standard day

Find: 1) Cruise Mach number and altitudes for long range cruise

2) Fuel required and time elapsed to fly 250 NMi.

Solution:

1. Determine configuration drag index from figure A1-5 by adding the various store drag numbers

Store	Location	Store Drag NO.
(6) 750 lb bombs	Centerline	75
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb'd	14

Configuration Drag Index = 103

2. Estimate Average Gross Weight

Initial Gross Weight = 47,000 lb

Estimated Fuel Used = 4000 lb

Estimated Final Gross Weight = 43,000 lb

Estimated Average

Gross Weight = $\frac{47,000 + 43,000}{2} = 45,000$ lb

3. Enter sample chart page A4-6 at configuration drag index = 103 (A), move up to estimated average gross weight (45,000 lb) (B), move to the right and read estimated average cruise pressure altitude = 26,800 ft, (C).

4. Enter ICAO density altitude chart, figure A1-9, with estimated cruise pressure altitude = 26,800 ft and read standard day temperature (-38°C). Ambient temperature = $(-38 + 15) = -23^\circ\text{C}$.

5. Re-enter sample chart page A4-6 at configuration drag index = 103 (A), move up to line (D), move across to the Mach number scale and read cruise Mach number = 0.849 (E). Parallel the guide lines from (E), until the ambient temperature (-23°C) is intercepted at (F). From (F), move to the right and intercept the zero wind-true airspeed reflector line, (G). Drop down to the velocity scale and read TAS = 524 knots, (H). From (G) continue across to a 40 knot tailwind at (J), and move up to the required range line = 250 NMi, (K). Move to the left and read elapsed time = 26.5 minutes, (L).

6. Enter sample chart page A4-8 at estimated gross weight = 45,000 lb, (M). Move up to configuration drag index = 103, (N). Move to the right and intercept true airspeed = 524 knots at (P) (see step 5). Move up to a time of 26.5 minutes, (Q) (see step 5), and move to the fuel used scale to read 2930 lb of fuel, (R).

7. Revise Estimated Average Gross Weight

Initial Gross Weight = 47,000 lb

Fuel Used Reading = 2930 lb

Final Gross Weight = 44,070 lb

Average Gross

Weight = $\frac{47,000 + 44,070}{2} = 45,535$ lb

8. Reworking steps 3, 4, 5 and 6 with revised average gross weight = 45,535 lb, the respective readings are:

Average Cruise-Climb Altitude = 26,700 ft

Temperature $(-37.9 + 15) = -22.9^\circ\text{C}$

True Airspeed = 524 knots

Time = 26.5 minutes

Fuel Used = 2940 lb

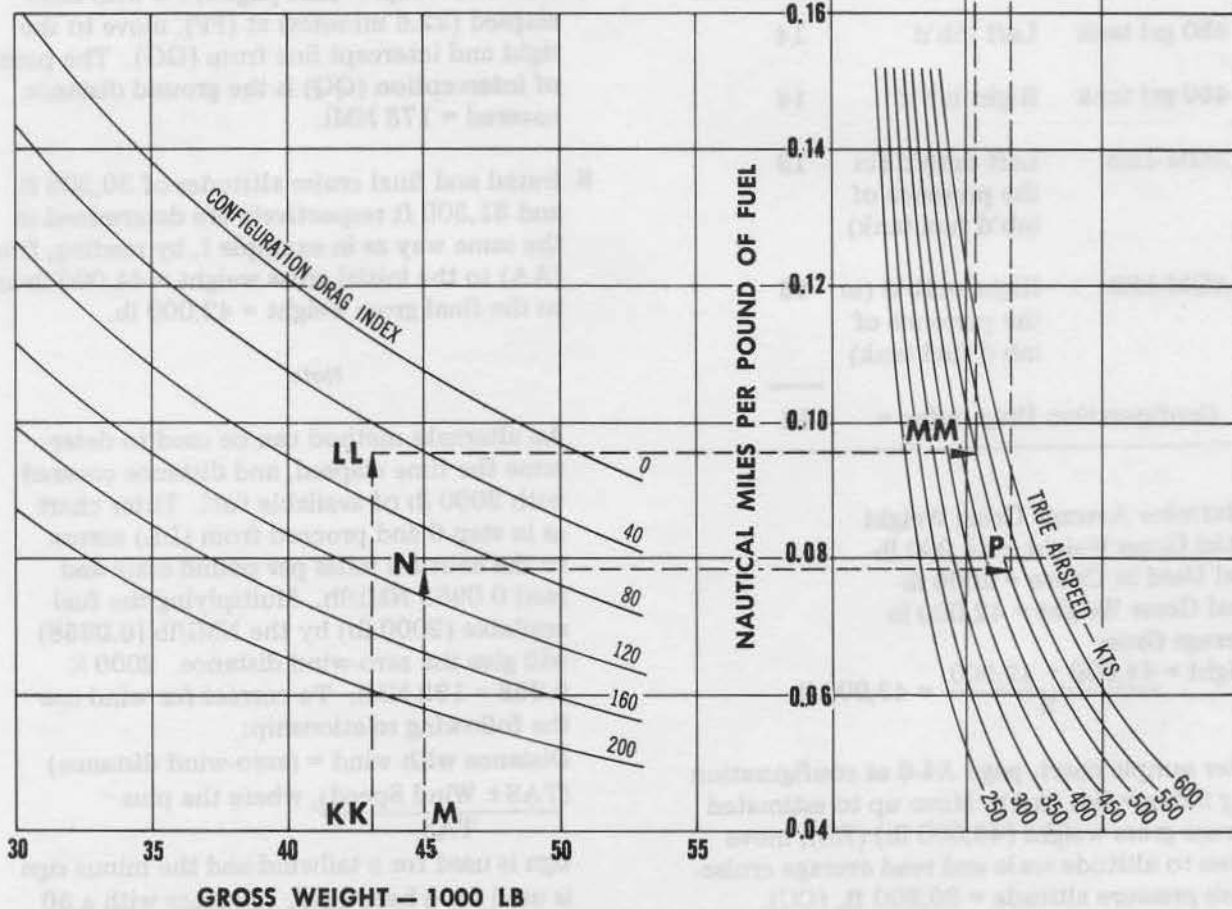
9. To find initial and final cruise-climb altitude enter sample chart page A4-6 at configuration drag index = 103, (A). Proceed to the initial gross weight = 47,000 lb, (S), move to the right and read initial cruise-climb pressure altitude, 25,900 ft, (T). Continue from (S) to final gross weight = 44,070 lb, (U). Move across and read final cruise pressure altitude, 27,200 ft, (V).

CRUISE CLIMB PERFORMANCE

NAUT MI/LB, FUEL FLOW, FUEL



SAMPLE CHART
Not to be used for
Flight Planning



EXAMPLE II

Conditions: Configuration: Clean + (2) 450 gal tanks (inboard) + (2) AGM-12B (outb'd)
Initial Gross Weight: 44,000 lb
Winds: Average 50 knot headwind
Ambient Temperature: 10°C colder than standard day

- Find: 1) Cruise Mach number and altitudes for long range cruise.
2) Ground distance available and time elapsed in cruising with 2000 lb of fuel.

Solution:

1. Determine the configuration drag index from figure A1-5 by adding the various store drag numbers.

	Store	Location	Store Drag NO.
(1)	450 gal tank	Left inb'd	14
(1)	450 gal tank	Right inb'd	14
(1)	AGM-12B	Left outb'd (in the presence of inb'd fuel tank)	13
(1)	AGM-12B	Right outb'd (in the presence of inb'd fuel tank)	13
Configuration Drag Index =			54

2. Determine Average Gross Weight
Initial Gross Weight = 44,000 lb
Fuel Used in Cruise = 2000 lb
Final Gross Weight = 42,000 lb
Average Gross Weight = $\frac{44,000 + 42,000}{2} = 43,000$ lb

3. Enter sample chart, page A4-6 at configuration drag index = 54, (AA). Move up to estimated average gross weight (43,000 lb) (BB), move across to altitude scale and read average cruise-climb pressure altitude = 30,900 ft, (CC).

4. Enter ICAO density altitude chart, figure A1-9, at 30,900 ft pressure altitude and read

standard day temperature = -46°C.
Ambient temperature = (-46°C + -10°C) = -56°C

5. Re-enter sample chart page A4-6 at configuration drag index = 54, (AA). Move up to line, (DD), move across to the Mach number scale and read cruise Mach number = 0.880, (EE). Continue from (EE), parallel to the guide lines until the ambient temperature (-56°C) is intercepted at (FF), move to the right until the 50 knot headwind is intercepted at (GG). Continue from (GG) to the zero wind-true airspeed reflector line (HH). Drop down to the velocity scale and read TAS = 508 knots, (JJ). From (GG) extend a line upward into the time-ground distance plot.
6. Enter sample chart page A4-8 at average gross weight = 43,000 lb, (KK), and move up to configuration drag index = 54, (LL). Move to the right to true airspeed - 508 knots, (MM). From (MM) move up to fuel available = 2000 lb at (NN) and read time elapsed = 22.6 minutes.
7. Re-enter sample chart page A4-6 with time elapsed (22.6 minutes) at (PP), move to the right and intercept line from (GG). The point of interception (QQ) is the ground distance covered = 173 NMi.
8. Initial and final cruise altitudes of 30,300 ft and 31,300 ft respectively are determined in the same way as in example I, by reading, from (AA) to the initial gross weight = 44,000 lb and to the final gross weight = 42,000 lb.

Note

An alternate method can be used to determine the time elapsed, and distance covered with 2000 lb of available fuel. Enter chart as in step 6 and proceed from (LL) across to the nautical miles per pound scale and read 0.0958 NMi/lb. Multiplying the fuel available (2000 lb) by the NMi/lb (0.0958) will give the zero-wind distance. $2000 \times 0.958 = 192$ NMi. To correct for wind use the following relationship:

Distance with wind = (zero-wind distance) $\frac{(TAS \pm Wind Speed)}{TAS}$

sign is used for a tailwind and the minus sign is used for a headwind. Distance with a 50 knot headwind = 192 (508-50)

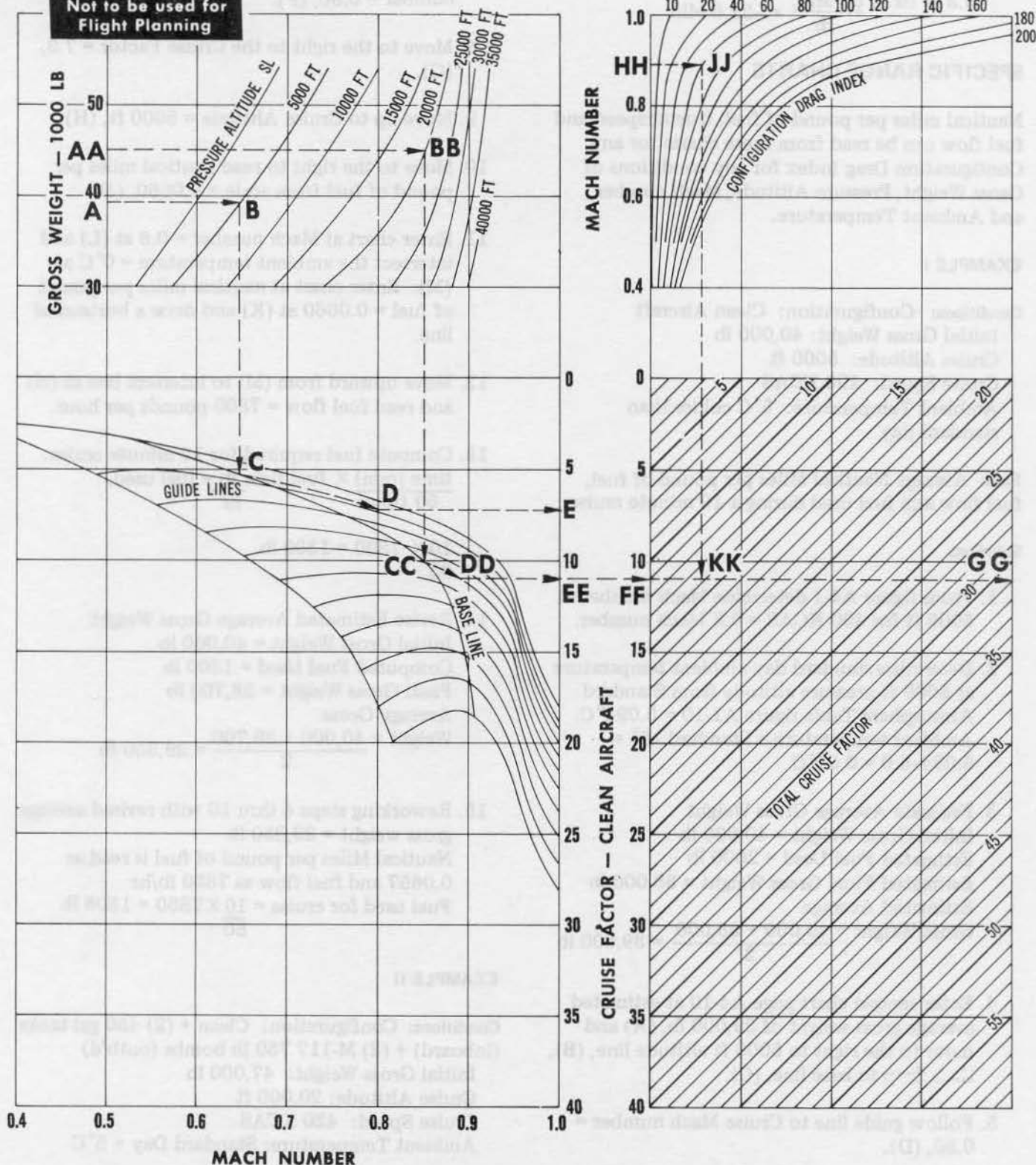
$\frac{192}{0.958} = 173$ NMi.

**SPECIFIC RANGE
CRUISE FACTOR FOR NAUTICAL
MILES PER POUND OF FUEL**

D

SAMPLE CHART

Not to be used for
Flight Planning



Note (continued)

$$\begin{aligned}\text{Time} &= \text{Distance with wind} \div \text{speed with} \\ \text{wind} &= 173 / (508 - 50) = 0.377 \text{ Hr.} \\ 0.377 \text{ Hr.} \times \frac{60 \text{ Min.}}{\text{Hr.}} &= -22.6 \text{ Min.}\end{aligned}$$

SPECIFIC RANGE CHARTS

Nautical miles per pound of fuel, true airspeed and fuel flow can be read from these charts for any Configuration Drag Index for any conditions of Gross Weight, Pressure Altitude, Mach number and Ambient Temperature.

EXAMPLE I

Conditions: Configuration: Clean Aircraft

Initial Gross Weight: 40,000 lb

Cruise Altitude: 5000 ft

Cruise Speed: 490 KCAS

Ambient Temperature: 5°C colder than standard day

Find: Average Nautical Miles per pound of fuel, fuel flow and fuel used during a 10 minute cruise.

Solution:

- From figure A4-1 determine Mach number at 5000 ft for 490 KCAS = 0.8 Mach number.
- Determine standard day ambient temperature at 5000 ft pressure altitude from Standard Atmosphere Table figure A1-10 = 5.094°C. Ambient temperature = Standard - 5° = 5.094 - 5.0 = 0.09°C
- Estimate Average Gross Weight
Initial Gross Weight = 40,000 lb
Estimated Fuel Used = 2000 lb
Estimated Final Gross Weight = 38,000 lb
Estimated Average
Gross Weight = $\frac{40,000 + 38,000}{2} = 39,000 \text{ lb}$
- Enter sample chart page A4-10 at estimated average gross weight of 39,000 lb, (A) and move to the right to 5000 ft altitude line, (B), then drop to base line, (C).
- Follow guide line to Cruise Mach number = 0.80, (D).
- Move to the right and read Cruise Factor - Clean Configuration = 7.3, (E).

7. Since no external stores are carried, go directly to the "Nautical miles per Pound of Fuel and Fuel Flow Chart." Enter chart page A4-12 at lower left hand corner at Cruise Mach number = 0.80, (F).

8. Move to the right to the Cruise Factor = 7.3, (G).

9. Move up to Cruise Altitude = 5000 ft, (H).

10. Move to the right to read nautical miles per pound of fuel from scale = 0.0660, (J).

11. Enter chart at Mach number = 0.8 at (L) and intersect the ambient temperature = 0°C at (M). Enter chart at nautical miles per pound of fuel = 0.0660 at (K) and draw a horizontal line.

12. Move upward from (M) to intersect line at (N) and read fuel flow = 7800 pounds per hour.

13. Compute fuel required for 10 minute cruise:
$$\frac{\text{time (min)}}{60 \text{ (min)}} \times \frac{\text{fuel flow lb}}{\text{hr}} = \text{fuel used.}$$

$$\frac{10 \times 7800}{60} = 1300 \text{ lb}$$

14. Revise Estimated Average Gross Weight
Initial Gross Weight = 40,000 lb
Computed Fuel Used = 1300 lb
Final Gross Weight = 38,700 lb
Average Gross
Weight = $\frac{40,000 + 38,700}{2} = 39,350 \text{ lb}$

15. Reworking steps 4 thru 10 with revised average gross weight = 39,350 lb
Nautical Miles per pound of fuel is read as 0.0657 and fuel flow as 7850 lb/hr
Fuel used for cruise = $\frac{10 \times 7850}{60} = 1308 \text{ lb}$

EXAMPLE II

Conditions: Configuration: Clean + (2) 450 gal tanks (inboard) + (2) M-117 750 lb bombs (outb'd)

Initial Gross Weight: 47,000 lb

Cruise Altitude: 20,000 ft

Cruise Speed: 420 KCAS

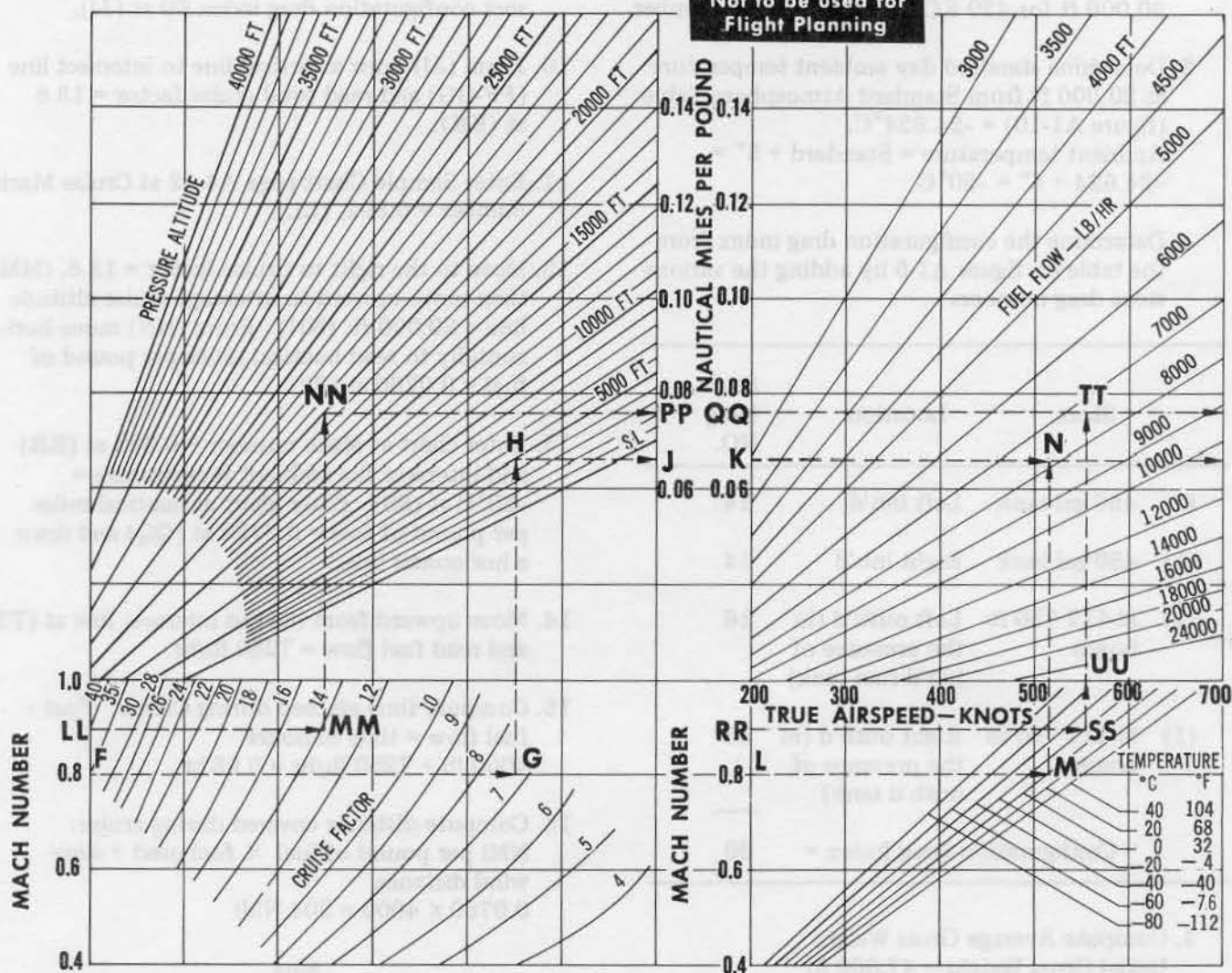
Ambient Temperature: Standard Day + 5°C

Find: Time elapsed, zero-wind distance covered, average fuel flow and nautical miles per pound of

**SPECIFIC RANGE
NAUTICAL MILES PER POUND
OF FUEL AND FUEL FLOW**



SAMPLE CHART
Not to be used for
Flight Planning



fuel, having available 4000 lb of fuel for cruise at constant altitude.

Solution:

1. From figure A4-1 determine Mach Number at 20,000 ft for 420 KCAS = 0.892 Mach number
2. Determine standard day ambient temperature at 20,000 ft from Standard Atmosphere Table (figure A1-10) = -24.624°C .
Ambient temperature = Standard + 5° = $-24.624 + 5^{\circ} = -20^{\circ}\text{C}$
3. Determine the configuration drag index from the table on figure A1-5 by adding the various store drag numbers

Store	Location	Store Drag NO.
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb'd	14
(1) M-117 750 lb bomb	Left outb'd (in the presence of inb'd fuel tank)	16
(1) M-117 750 lb bomb	Right outb'd (in the presence of outb'd tank)	16
Configuration Drag Index =		60

4. Compute Average Gross Weight
Initial Gross Weight = 47,000 lb
Fuel Used for Cruise = 4000 lb
Final Gross Weight = 43,000 lb
Average Gross Weight = $\frac{47,000 + 43,000}{2} = 45,000$ lb
5. Enter sample chart page A4-10 at average gross weight = 45,000 lb, (AA), and move to the right to 20,000 ft altitude line, (BB), then drop down to base line, (CC).
6. Follow guide line to Cruise Mach number = 0.892, (DD).
7. Move to the right and read Cruise Factor — Clean Configuration = 11.0, (EE).

8. Enter Sample Chart page A4-10 at Cruise Factor — Clean Configuration = 11.0 (FF) and draw a horizontal line (FF-GG).

9. Enter Mach number scale at cruise Mach = 0.892, (HH) and move to the right to intersect configuration drag index 60 at (JJ).
10. From (JJ) draw a vertical line to intersect line (FF-GG) and read total cruise factor = 13.8 at (KK).
11. Enter Sample Chart page A4-12 at Cruise Mach number = 0.892, (LL).
12. Move to the right to Cruise factor = 13.8, (MM) then move upward to intercept cruise altitude line = 20,000 ft, (NN). From (NN) move horizontally to read nautical miles per pound of fuel = 0.0760 at (PP).
13. Enter chart at Mach number = 0.892 at (RR) and intersect the ambient temperature = -20°C at (SS). Enter chart at nautical miles per pound of fuel = 0.0760 at (QQ) and draw a horizontal line.
14. Move upward from (SS) to intersect line at (TT) and read fuel flow = 7250 lb/hr.
15. Compute time elapsed during Cruise: Fuel $\div$ fuel flow = time in hours
 $4000 \text{ lb} \div 7250 \text{ lb/hr} = 0.55 \text{ hr}$.
16. Compute distance covered during cruise:
NMI per pound of fuel $\times$ fuel used = zero-wind distance
 $0.0760 \times 4000 = 304 \text{ NMI}$

Note

To correct distance for prevailing winds use the following relationship.
Distance with wind = (zero-wind distance) $\frac{(\text{TAS} \pm \text{Wind Speed})}{\text{TAS}}$

The plus sign is used for a tailwind and the minus used for a headwind.

Examples: To correct the no-wind distance of 304 NMI (computed in step 16) for a prevailing headwind of 20 knots, read true airspeed = 552 knots at (UU).

Then, $(304 \text{ NMI}) \frac{(552-20)}{552} =$

293 NMI with 20 knot headwind

DIVERSION SUMMARY TABLES

Diversion Range and Diversion Endurance Summary Tables are each presented for four configuration drag indices. Since the variation between adjacent configurations is small, the chart which comes closest in drag index to the configuration flown may be used.

These tables are provided to determine range (or time) available with various values of fuel remaining. Included in the range charts are four flight profiles, as follows:

- (A) Cruise at initial altitude until over base. Time and fuel are included for a penetration descent at destination, but range does not include descent distance.
- (B) Cruise at initial altitude and descend on course. Time and fuel are included for a maximum range descent at destination and range includes the on-course descent distance.
- (C) Use optimum altitude over base. Time and fuel are included for a military thrust climb to optimum altitude and a penetration descent at destination. Range includes on-course climb distance but does not include descent distance.
- (D) Use optimum altitude and descend on course. Time and fuel are included for a Military Thrust climb to optimum altitude and a maximum range descent at destination. Range includes both the on-course climb and descent distances.

The endurance charts show flight time available at speeds for maximum endurance for the following two profiles:

- (A) Loiter at initial altitude. Time and fuel included for a maximum range descent to sea level destination.
- (B) Climb to and loiter at optimum altitude. Time and fuel included for both a Military Thrust climb to optimum altitude and a maximum range descent to sea level destination.

Sample Problem

Given:

Clean aircraft [947] C/W plus (2) 450-gallon tanks with 3000 lbs of fuel on board at 15,000 feet pressure altitude.

- Find: (a) Zero wind distance available at optimum altitude.
- (b) Zero wind endurance time at optimum altitude.

Solution:

- Determine the configuration drag index from figure A1-5 by adding the various store drag numbers.

	Store Drag NO.
Clean Aircraft [947] C/W	20
(1) 450 gal tank, right inb'd	14
(1) 450 gal tank, left inb'd	14
Configuration Drag Index =	48

The chart closest to a configuration index of 48 is the one for configuration drag index = 52.

- Enter Diversion Range Summary Chart for drag index of 52 (page A4-26) at initial altitude of 15,000 feet and 3000 lbs of fuel onboard, and read:
 - (a) For profile (C), climb to 30,000 feet to realize a 160 nautical mile zero-wind range over destination and arrive at sea level destination with 1000 lb approach and landing reserve. Flight time is 24.7 minutes. Cruise speed at 30,000 feet is shown at the bottom of the chart to be 0.85 Mach.
 - (b) For profile (D), climb to 35,000 feet to realize a 262 nautical mile zero-wind range, of which 64 nautical miles is the maximum range descent distance to sea level destination, and arrive with 1000 lb approach and landing reserve. Flight time is 34.9 minutes and cruise speed is 0.87 Mach.
- Enter Diversion Endurance Summary Chart for drag index of 52 (page A4-30) at initial altitude of 15,000 feet and 3000 lbs of fuel on board. For profile (B), climb to 35,000 feet to realize 36.9 minutes in flight, of which 11.6 minutes is the maximum range descent time to sea level destination, and arrive with 1000 lb approach and landing reserve. Loiter at 35,000 feet at 0.79 Mach number.

MACH NUMBER — CALIBRATED AIRSPEED CHART

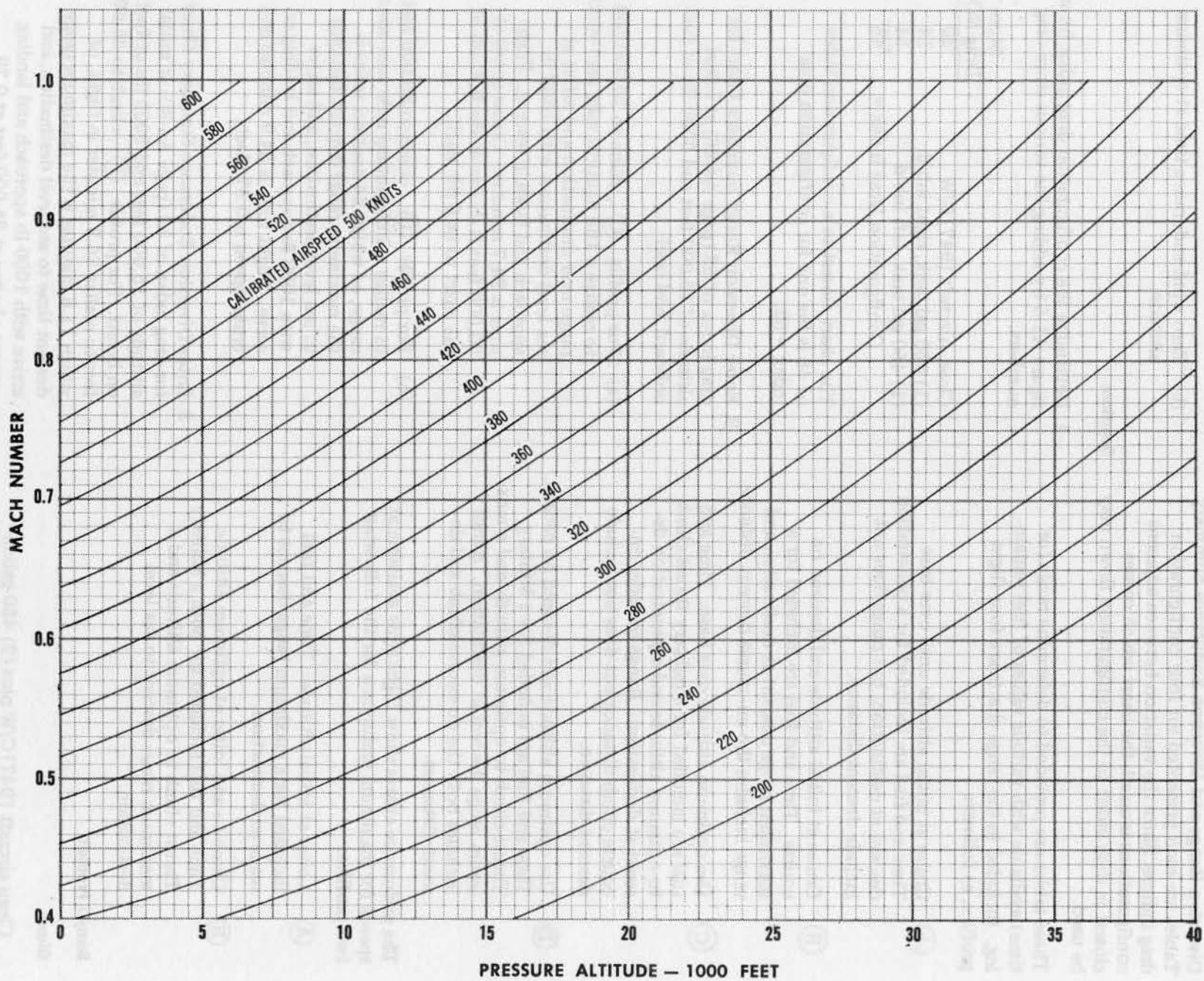


Figure A4-1

CONSTANT ALTITUDE LONG RANGE CRUISE MACH NUMBER AND TIME

D

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

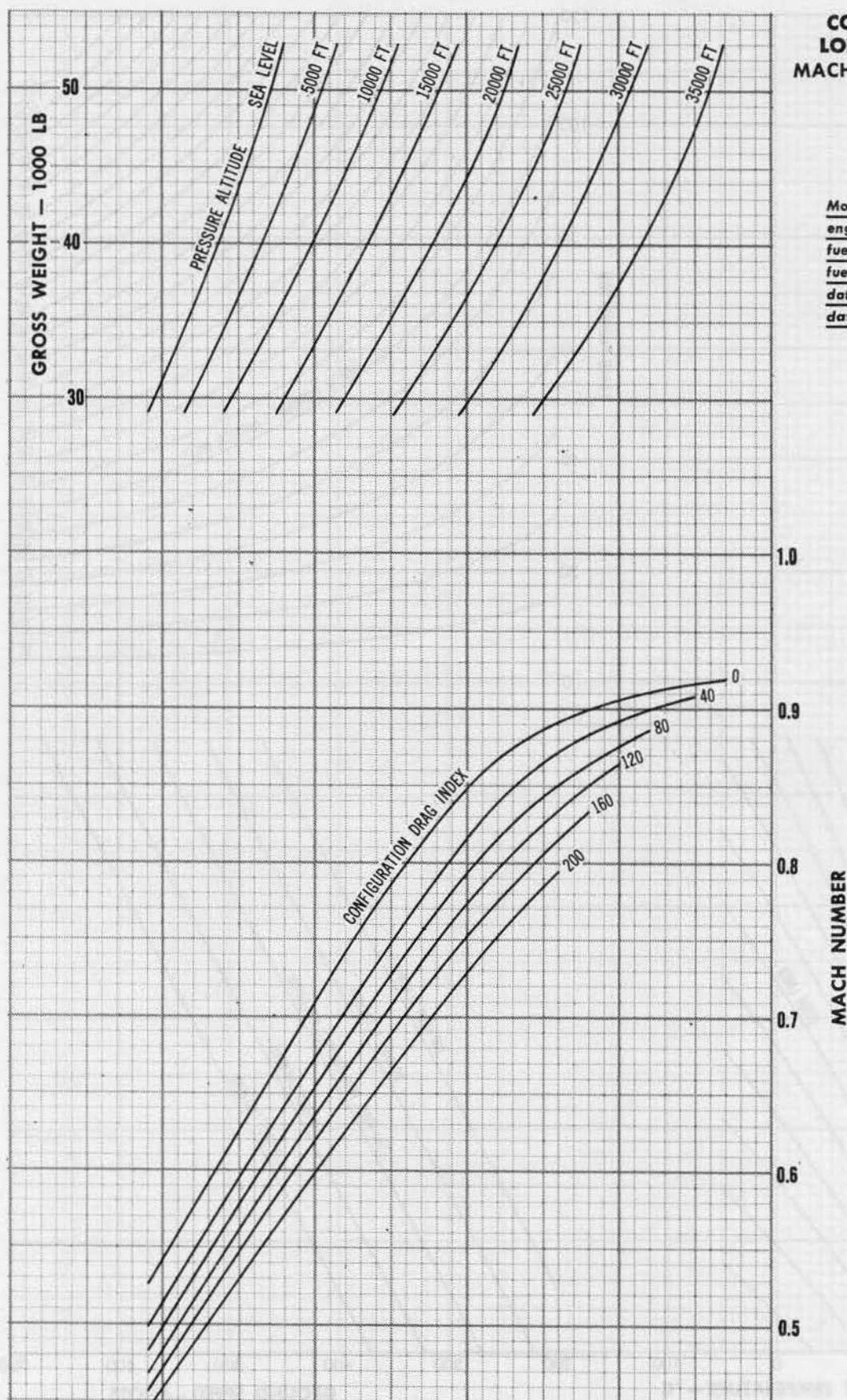


Figure A4-2 (Sheet 1 of 3)

CONSTANT ALTITUDE
LONG RANGE CRUISE
MACH NO. AND TIME



model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB 1963
data basis: FLIGHT TEST

PRESSURE ALTITUDE 1000 FT	STD DAY TEMP °C
0	15
5	5
10	-5
15	-15
20	-25
25	-35
30	-44
35	-54
40	-57

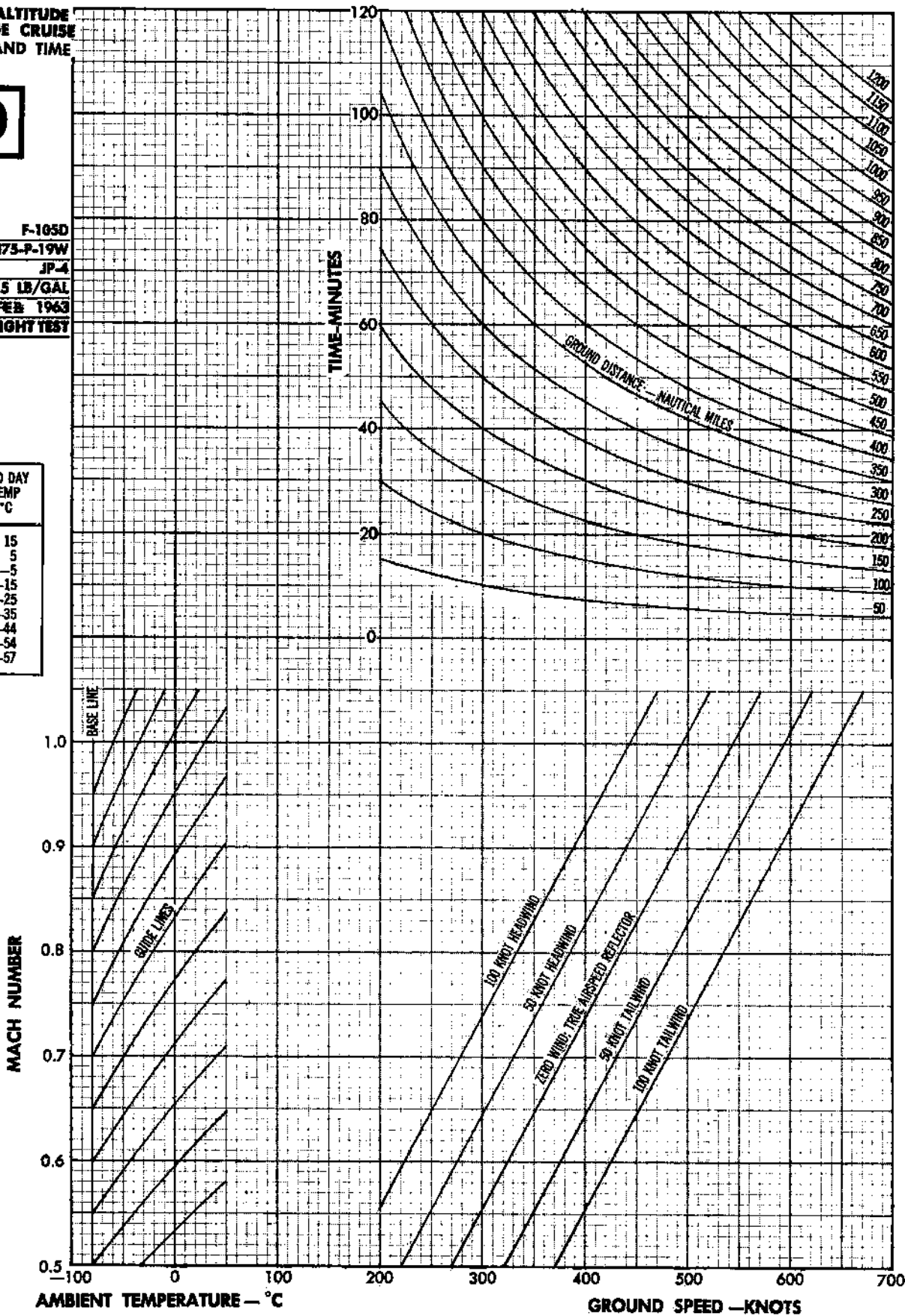


Figure A4-2 (Sheet 2 of 3)

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST



**CONSTANT ALTITUDE
 LONG RANGE CRUISE**
 NAUTICAL MILES PER POUND
 OF FUEL, FUEL FLOW
 AND FUEL USED

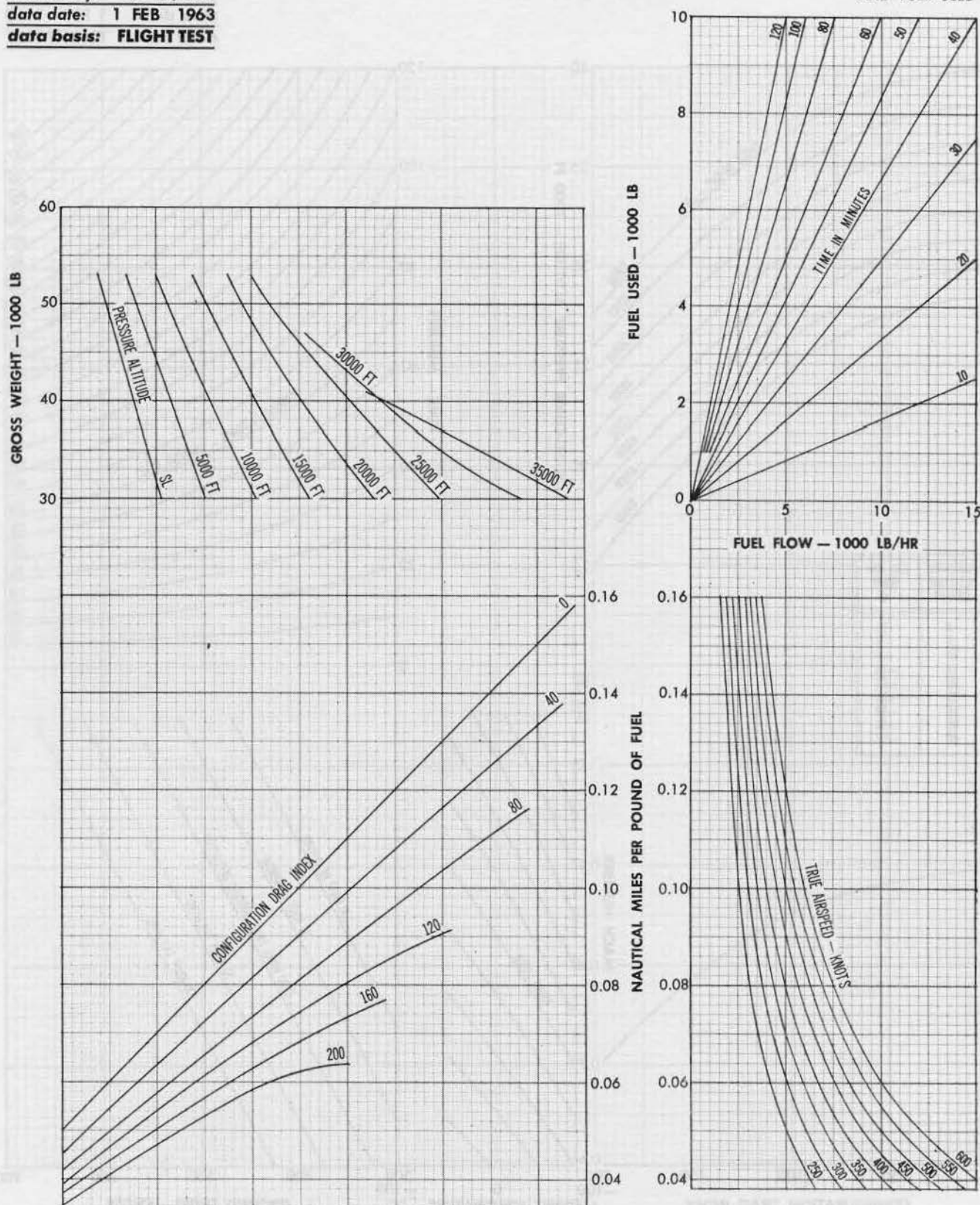


Figure A4-2 (Sheet 3 of 3)

CRUISE CLIMB PERFORMANCE
CRUISE ALTITUDE, MACH NUMBER AND TIME



model: **F-105D**
engine: **J75-P-19W**
fuel grade: **JP-4**
fuel density: **6.5 LB/GAL**
data date: **1 FEB 1963**
data basis: **FLIGHT TEST**

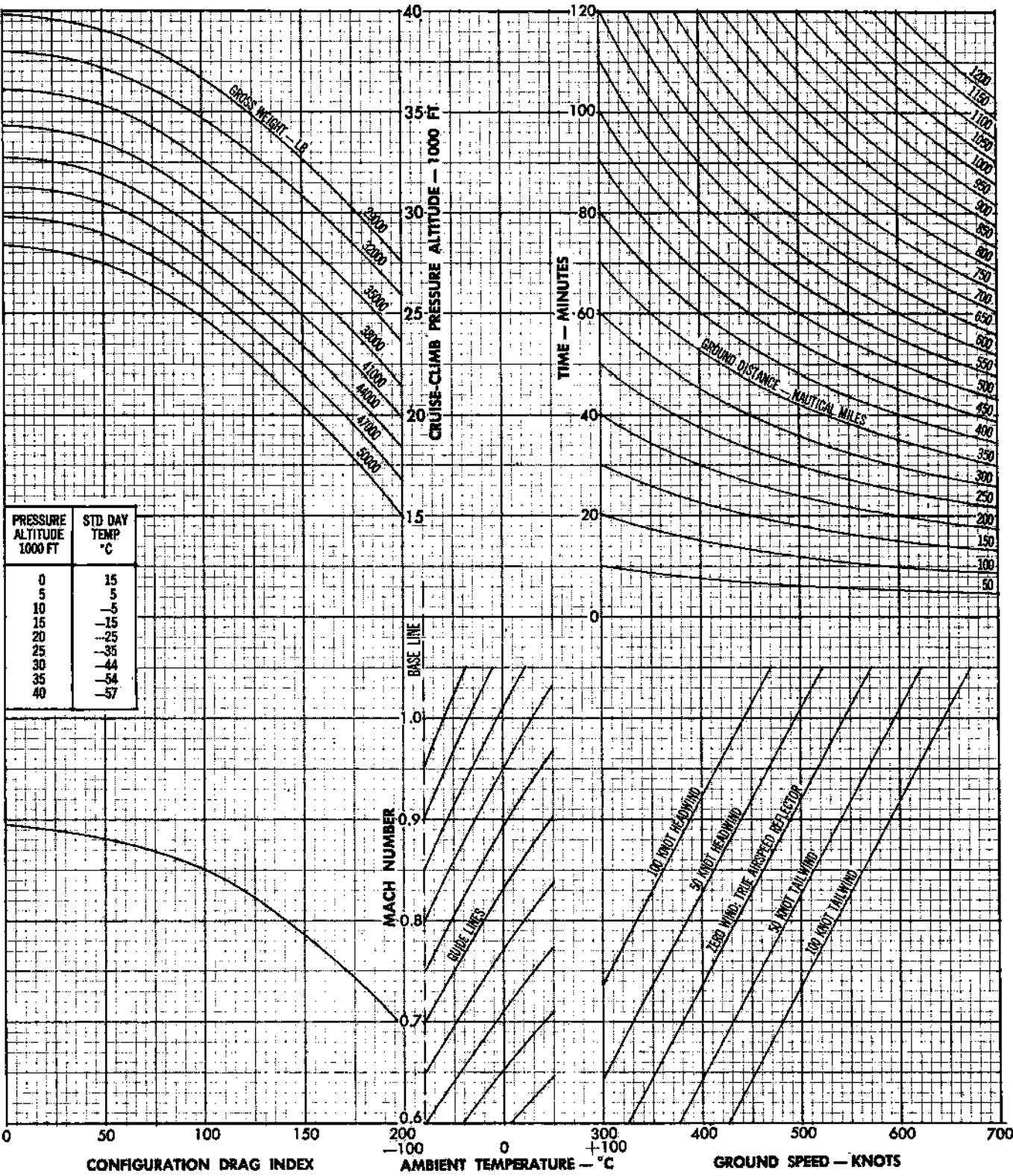


Figure A4-3 (Sheet 1 of 2)

model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB 1963
data basis: FLIGHT TEST



CRUISE CLIMB PERFORMANCE
NAUTICAL MILES PER POUND OF FUEL,
FUEL FLOW AND FUEL USED

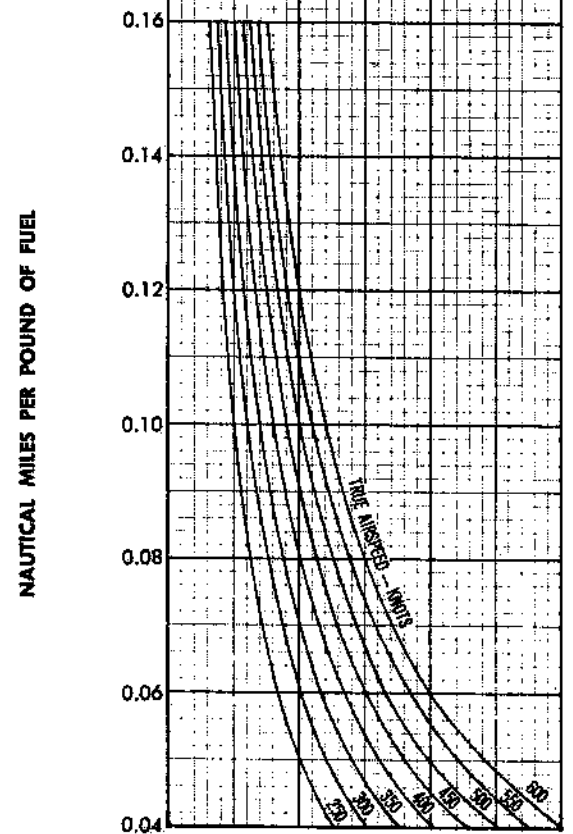
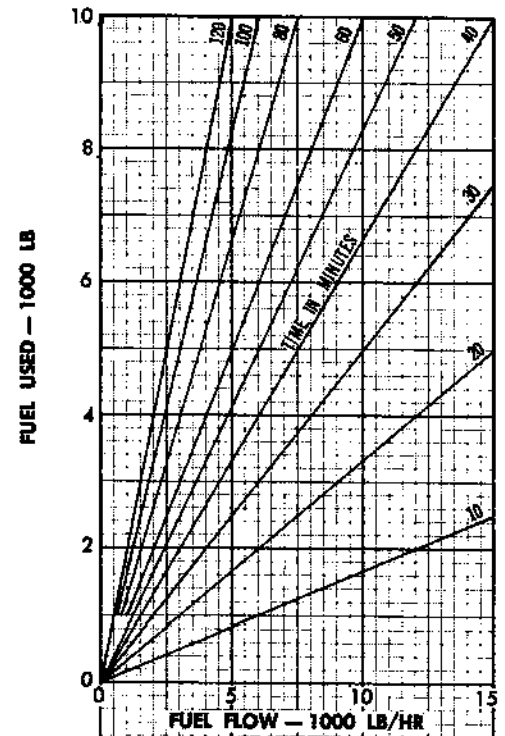
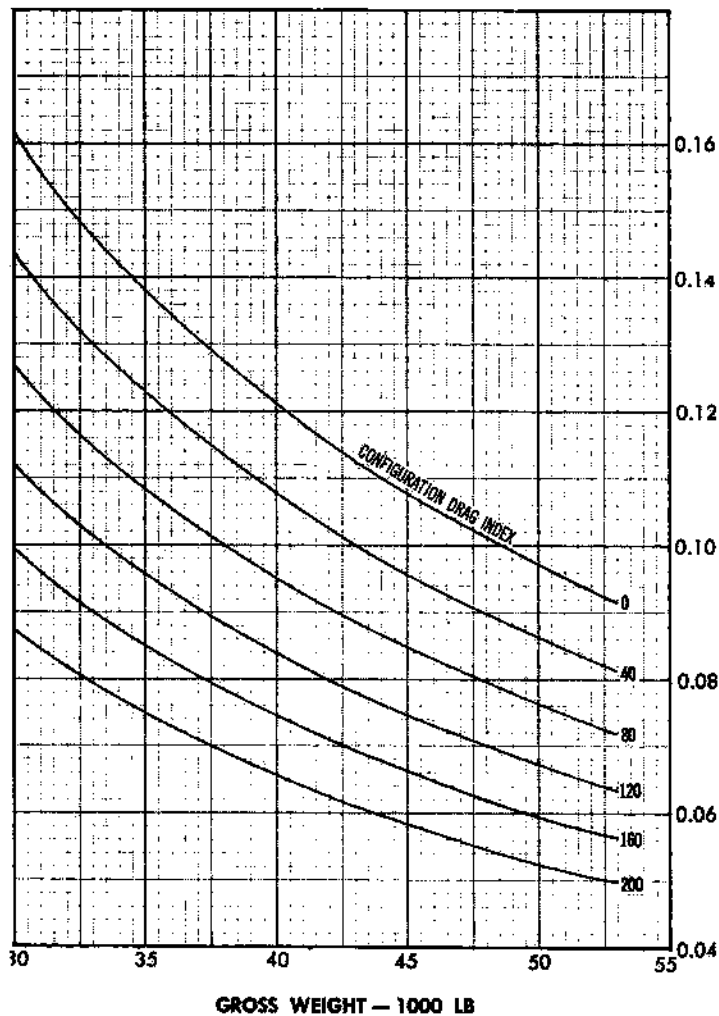


Figure A4-3 (Sheet 2 of 2)

SPECIFIC RANGE
CRUISE FACTOR FOR NAUTICAL
MILES PER POUND OF FUEL

D

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

GROSS WEIGHT — 1000 LB.

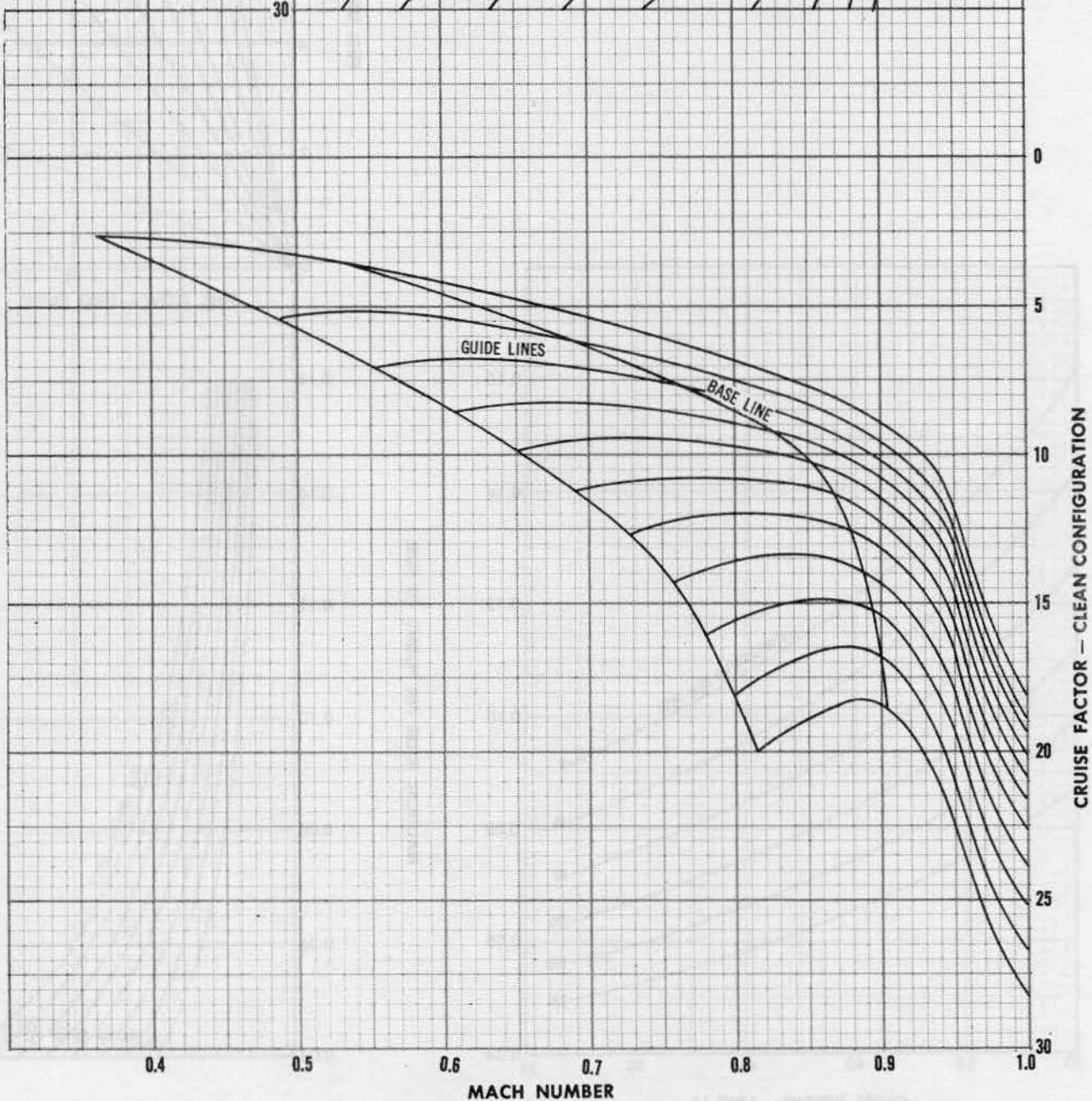
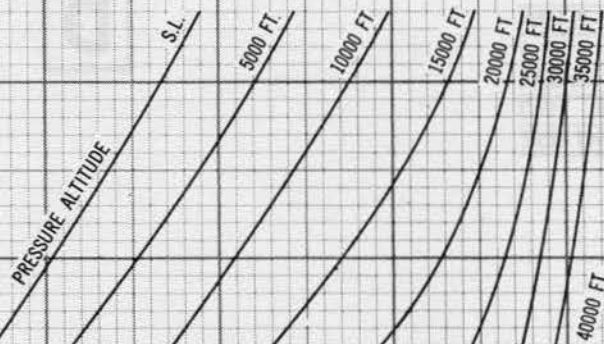
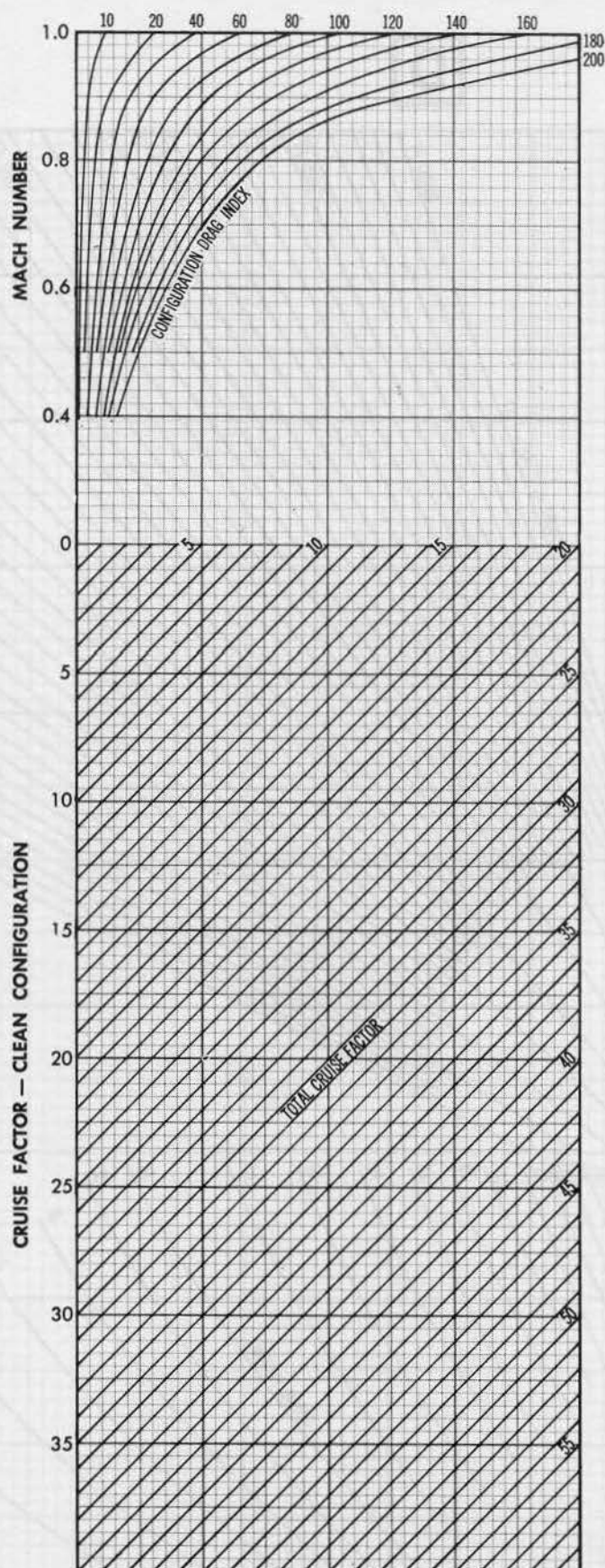


Figure A4-4 (Sheet 1 of 4)



SPECIFIC RANGE
CRUISE FACTOR FOR NAUTICAL
MILES PER POUND OF FUEL

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST

D

Figure A4-4 (Sheet 2 of 4)

**SPECIFIC RANGE
NAUTICAL MILES PER POUND
OF FUEL AND FUEL FLOW**

D

model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB 1963
data basis: FLIGHT TEST

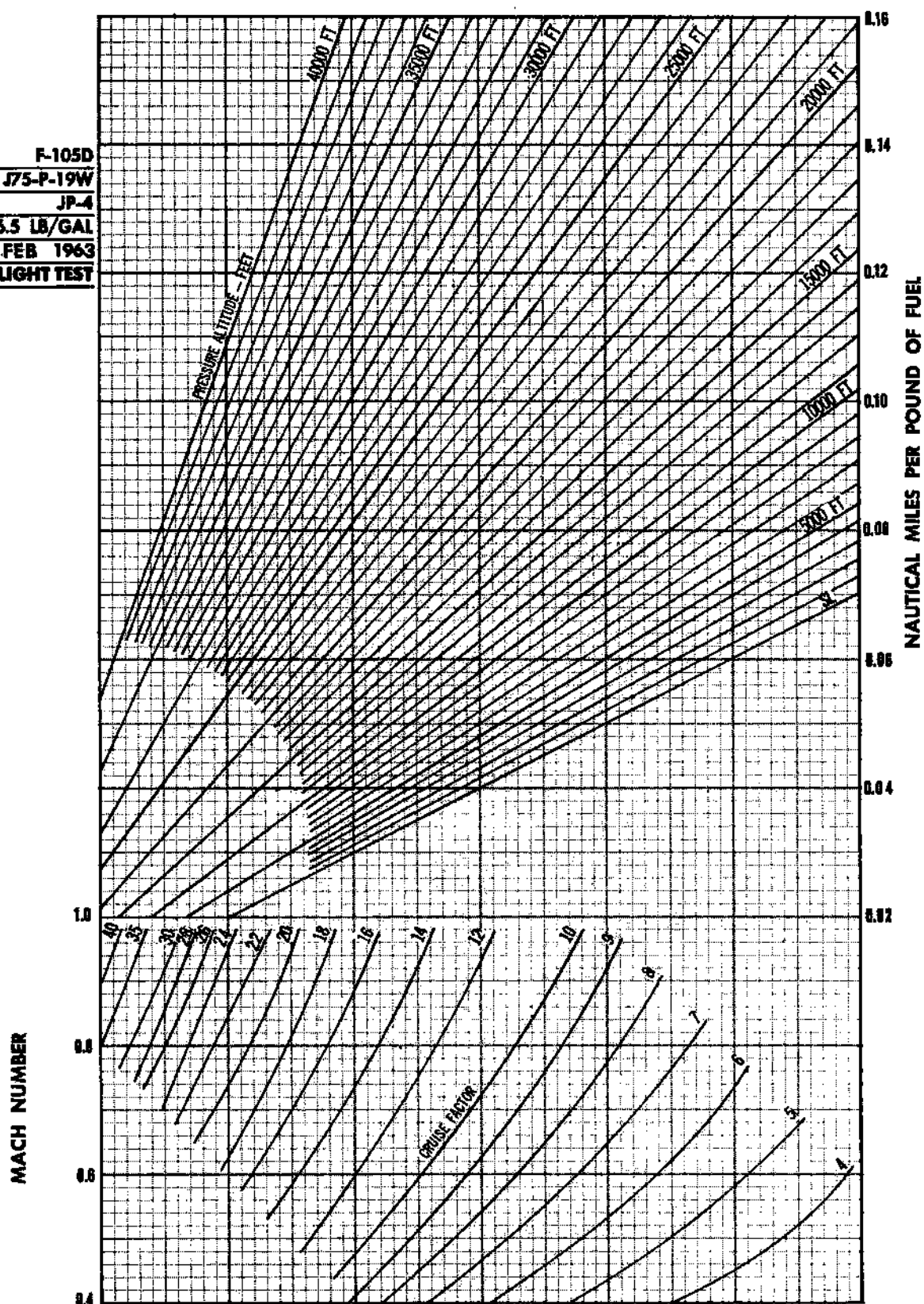
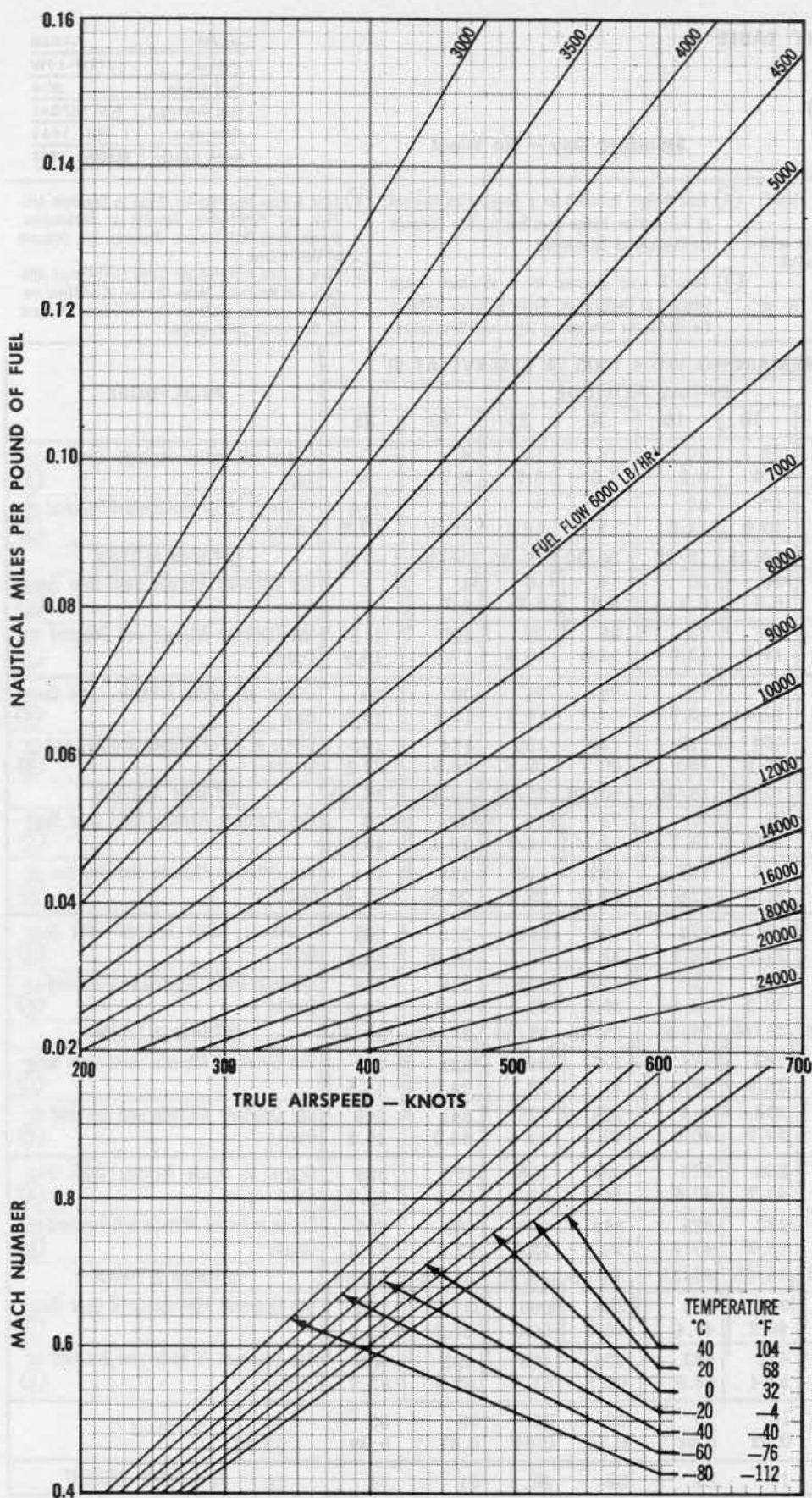


Figure A4-4 (Sheet 3 of 4)

SPECIFIC RANGE
NAUTICAL MILES PER POUND
OF FUEL AND FUEL FLOW

D

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST



PRESSURE ALTITUDE 1000 FT	STD DAY TEMP °C
0	15
5	5
10	-5
15	-15
20	-25
25	-35
30	-44
35	-54
40	-57

Figure A4-4 (Sheet 4 of 4)

DIVERSION RANGE SUMMARY TABLE


 CONFIGURATION
DRAG INDEX

0

Standard Day — No Wind

 model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

Climb at 0.88 True Mach No. with Military Thrust.

 * Schedules Provide For Arrival at Sea Level with
1000 LB Fuel — Approach and Landing Reserve.

 With Over 3000 LB of Fuel Remaining, Fly at
35000 FT at M 0.89 for Optimum Range.

 (A) Time & Fuel Included for a Penetration Descent
at Destination. Range Does Not Include Distance
for Descent at Destination.

 (B) Time & Fuel Included for a Maximum Range
Descent at Destination. Range Includes Distance
for On-Course Descent to Sea Level Destination.

 (C) Time & Fuel Included for Climb to Optimum Altitude
and Penetration Descent at Destination.
Range Does Not Include Distance for Descent
at Destination.

 (D) Time & Fuel Included for Climb to Optimum Altitude
and Maximum Range Descent at Destination.
Range Includes Distance for On-Course Descent
to Sea Level Destination.

TOTAL FUEL ON BOARD LB	RANGE AND TIME REMAINING WITH 1000 LB RESERVE AT SL									PROCEDURE
	INITIAL ALTITUDE									
	1000 FT	SL	5	10	15	20	25	30	35	
1500	NAUT MI	36	30	26	20	14	10	4	-	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	6.2	6.2	6.5	6.5	6.6	6.7	6.7	-	
	NAUT MI	36	45	57	67	79	91	102	114	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	6.2	8.1	10.0	11.6	13.1	14.7	16.0	17.7	
	1000 FT	SL/15	5/20	10/25	15/25	20/30	25/35	30/35	-/40	OPTIMUM ALTITUDE
2000	NAUT MI	36	30	26	20	14	10	4	-	Use Optimum Altitude Until Over Base (C)
	MINUTES	6.2	6.2	6.5	6.5	6.6	6.7	6.7	-	
	NAUT MI	48	58	69	75	85	99	109	115	Use Optimum Altitude and Descend on Course (D)
	MINUTES	8.6	9.9	11.7	12.6	14.0	15.9	17.0	18.1	
	1000 FT	SL/35	5/35	10/40	15/40	20/40	25/40	30/40	35/40	OPTIMUM ALTITUDE
3000	NAUT MI	71	70	71	71	72	74	76	76	Use Optimum Altitude Until Over Base (C)
	MINUTES	12.2	12.7	13.4	13.7	14.2	14.5	15.1	16.0	
	NAUT MI	120	132	148	157	169	178	187	194	Use Optimum Altitude and Descend on Course (D)
	MINUTES	18.2	19.5	21.8	22.9	24.2	25.4	26.5	27.3	
	1000 FT	35/35	35/35	35/40	35/40	35/40	35/40	35/40	35/40	OPTIMUM ALTITUDE
4000	NAUT MI	141	151	161	174	186	202	218	232	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	24.2	25.7	27.1	28.3	29.3	30.2	31.9	34.5	
	NAUT MI	141	166	192	220	250	283	316	349	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	24.2	27.5	30.4	33.4	35.6	38.1	41.2	45.5	
	1000 FT	35/35	35/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
5000	NAUT MI	159	171	183	194	205	214	222	232	Use Optimum Altitude Until Over Base (C)
	MINUTES	25.4	26.8	28.3	29.6	31.0	32.1	33.0	34.5	
	NAUT MI	276	288	302	314	324	332	341	349	Use Optimum Altitude and Descend on Course (D)
	MINUTES	36.6	38.0	39.7	40.9	42.3	43.4	44.3	45.3	
	1000 FT	35/35	35/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
6000	NAUT MI	211	230	250	275	299	328	359	388	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	36.2	38.4	40.7	42.8	44.2	45.7	48.4	52.9	
	NAUT MI	211	245	282	322	363	409	456	505	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	36.2	39.9	43.9	47.7	50.3	53.3	57.6	63.9	
	1000 FT	35/35	35/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
7000	NAUT MI	309	322	335	345	356	366	375	388	Use Optimum Altitude Until Over Base (C)
	MINUTES	43.0	44.6	46.3	47.4	48.8	50.0	51.2	52.9	
	NAUT MI	427	439	452	463	474	483	492	505	Use Optimum Altitude and Descend on Course (D)
	MINUTES	54.3	55.8	57.4	58.8	60.1	61.2	62.2	63.9	
	1000 FT	35/35	35/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
Cruise Altitude		SL	5	10	15	20	25	30	35	Cruise Speed
True Mach No		0.53	0.57	0.62	0.68	0.74	0.81	0.87	0.89	
DESCENT DIST NAUT MI		-	9	19	28	39	49	61	74	MAX RANGE DESCENT
									89	

Figure A4-5 (Sheet 1 of 4)

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

DIVERSION RANGE SUMMARY TABLE

CONFIGURATION
 DRAG INDEX ► 28

D

Standard Day — No Wind

Climb at 0.88 True Mach No. with Military Thrust.

* Schedules Provide For Arrival at Sea Level with 1000 LB Fuel — Approach and Landing Reserve.

With Over 3000 LB of Fuel Remaining, Fly at 35000 FT at M 0.88 for Optimum Range.

(A) Time & Fuel Included for a Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(B) Time & Fuel Included for a Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

(C) Time & Fuel Included for Climb to Optimum Altitude and Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(D) Time & Fuel Included for Climb to Optimum Altitude and Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

*TOTAL FUEL ON BOARD LB	RANGE AND TIME REMAINING WITH 1000 LB RESERVE AT SL									PROCEDURE	
	1000 FT	INITIAL ALTITUDE									
		SL	5	10	15	20	25	30	35		
1500	NAUT MI	33	28	24	20	15	11	6	-	Cruise at Initial Altitude Until Over Base (A)	
	MINUTES	5.7	5.8	6.2	6.3	6.4	6.6	6.6	-		
	NAUT MI	33	42	53	62	73	85	96	107	Cruise at Initial Altitude and Descend on Course (B)	
	MINUTES	5.7	7.4	9.4	10.8	12.2	13.7	15.3	16.9		
	1000 FT	SL/10	5/15	10/20	15/25	20/30	25/35	30/35	-/40	OPTIMUM ALTITUDE	
2000	NAUT MI	33	28	24	20	15	11	6	-	Use Optimum Altitude Until Over Base (C)	
	MINUTES	5.7	5.8	6.2	6.3	6.4	6.6	6.6	-		
	NAUT MI	40	49	60	72	81	91	99	109	Use Optimum Altitude and Descend on Course (D)	
	MINUTES	6.9	8.6	10.2	11.7	13.4	14.9	15.8	17.3		
	1000 FT	SL/30	5/30	10/35	15/40	20/40	25/40	30/40	35/40	OPTIMUM ALTITUDE	
3000	NAUT MI	66	66	66	67	68	69	71	71	Use Optimum Altitude Until Over Base (C)	
	MINUTES	11.4	12.0	12.7	13.2	13.6	13.9	14.4	15.2		
	NAUT MI	100	115	132	144	154	164	172	179	Use Optimum Altitude and Descend on Course (D)	
	MINUTES	15.4	17.3	19.5	21.2	22.5	23.6	24.5	25.4		
	1000 FT	30/35	30/35	30/35	30/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE	
4000	NAUT MI	131	139	149	160	171	185	200	211	Use Optimum Altitude Until Over Base (C)	
	MINUTES	22.1	23.8	25.4	26.8	29.0	30.0	31.0	32.0		
	NAUT MI	241	257	270	282	294	303	312	319	Use Optimum Altitude and Descend on Course (D)	
	MINUTES	32.7	34.7	36.1	37.7	39.3	40.3	41.3	42.3		
	1000 FT	35/35	35/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE	
1500	NAUT MI	196	213	231	251	274	300	326	347	Use Optimum Altitude Until Over Base (C)	
	MINUTES	33.9	40.8	42.6	44.0	45.3	46.4	47.4	48.3		
	NAUT MI	378	396	408	420	431	439	446	456	Use Optimum Altitude and Descend on Course (D)	
	MINUTES	48.9	51.1	52.7	54.2	55.5	56.6	57.5	58.6		
	1000 FT	35/35	35/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE	
Cruise Altitude True Mach No		SL	5	10	15	20	25	30	35	40	Cruise Speed
		0.52	0.56	0.61	0.66	0.72	0.79	0.85	0.88	0.89	
DESCENT DIST NAUT MI -		8	18	26	36	45	56	68	82	MAX RANGE DESCENT	

Figure A4-5 (Sheet 2 of 4)

DIVERSION RANGE SUMMARY TABLE

CONFIGURATION
DRAG INDEX

► 52

Standard Day — No Wind

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

Climb at 0.86 True Mach No. with Military Thrust.

* Schedules Provide For Arrival at Sea Level with 1000 LB Fuel — Approach and Landing Reserve.

With Over 3500 LB of Fuel Remaining, Fly at 35000 FT at M 0.87 for Optimum Range.

(A) Time & Fuel Included for a Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(B) Time & Fuel Included for a Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

(C) Time & Fuel Included for Climb to Optimum Altitude and Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(D) Time & Fuel Included for Climb to Optimum Altitude and Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

*TOTAL FUEL ON BOARD LB	RANGE AND TIME REMAINING WITH 1000 LB RESERVE AT SL									PROCEDURE
		INITIAL ALTITUDE								
	1000 FT	SL	5	10	15	20	25	30	35	
1500	NAUT MI	31	27	23	19	15	11	7	-	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	5.4	5.8	5.9	6.2	6.3	6.4	6.5	-	
	NAUT MI	31	40	49	60	69	80	90	103	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	5.4	7.2	8.7	10.3	11.7	13.0	14.4	16.2	
	1000 FT	SL/5	5/15	10/20	15/25	20/25	25/30	30/35	-/35	OPTIMUM ALTITUDE
2000	NAUT MI	31	27	23	19	15	11	7	-	Use Optimum Altitude Until Over Base (C)
	MINUTES	5.4	5.8	5.9	6.2	6.3	6.4	6.5	-	
	NAUT MI	36	47	55	63	74	82	94	103	Use Optimum Altitude and Descend on Course (D)
	MINUTES	6.4	7.6	9.3	10.8	12.0	13.4	15.0	16.2	
	1000 FT	SL/25	5/30	10/35	15/35	20/35	25/35	30/35	35/35	OPTIMUM ALTITUDE
3000	NAUT MI	62	62	63	63	64	65	68	68	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	10.9	11.6	12.1	12.6	12.9	13.3	13.8	14.5	
	NAUT MI	62	75	89	104	118	134	151	170	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	10.9	13.0	14.9	16.7	18.4	19.9	21.7	24.2	
	1000 FT	SL/25	5/30	10/35	15/35	20/35	25/35	30/35	35/35	OPTIMUM ALTITUDE
4000	NAUT MI	62	62	63	63	64	65	68	68	Use Optimum Altitude Until Over Base (C)
	MINUTES	10.9	11.6	12.1	12.6	12.9	13.3	13.8	14.5	
	NAUT MI	85	99	115	127	143	153	162	170	Use Optimum Altitude and Descend on Course (D)
	MINUTES	13.1	15.0	17.5	18.9	20.8	22.1	23.7	24.2	
	1000 FT	SL/25	5/30	10/35	15/35	20/35	25/35	30/35	35/35	OPTIMUM ALTITUDE
5000	NAUT MI	124	131	140	149	161	173	188	199	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	21.7	23.0	24.1	25.2	26.2	27.0	28.2	30.0	
	NAUT MI	124	144	166	190	215	242	271	301	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	21.7	24.5	26.9	29.3	31.6	33.7	36.1	39.7	
	1000 FT	25/35	25/35	30/35	30/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
6000	NAUT MI	124	137	151	160	175	183	193	199	Use Optimum Altitude Until Over Base (C)
	MINUTES	20.3	21.9	23.5	24.7	27.0	28.0	29.4	30.0	
	NAUT MI	216	233	250	262	274	285	295	301	Use Optimum Altitude and Descend on Course (D)
	MINUTES	29.4	31.3	33.2	34.9	36.5	37.7	39.1	39.7	
	1000 FT	25/35	25/35	30/35	30/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
7000	NAUT MI	185	200	217	235	256	279	306	327	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	32.4	34.4	36.1	37.8	39.1	40.5	42.4	45.2	
	NAUT MI	185	213	243	276	311	348	389	429	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	32.4	35.9	38.9	41.9	44.7	47.2	50.3	54.9	
	1000 FT	35/35	35/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
8000	NAUT MI	243	259	276	288	300	310	320	327	Use Optimum Altitude Until Over Base (C)
	MINUTES	34.9	36.6	38.7	40.3	41.9	43.3	44.4	45.2	
	NAUT MI	345	361	376	390	400	412	422	429	Use Optimum Altitude and Descend on Course (D)
	MINUTES	44.6	46.3	48.3	50.0	51.6	53.0	54.1	54.9	
	1000 FT	35/35	35/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
Cruise Altitude		SL	5	10	15	20	25	30	35	Cruise Speed
True Mach No		0.52	0.56	0.61	0.66	0.72	0.79	0.85	0.87	
DESCENT DIST NAUT MI -		8	17	25	34	43	54	64		MAX RANGE DESCENT

Figure A4-5 (Sheet 3 of 4)

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

DIVERSION RANGE SUMMARY TABLE

 CONFIGURATION
 DRAG INDEX

72

D

Standard Day — No Wind

Climb at 0.86 True Mach No. with Military Thrust.

 * Schedules Provide For Arrival at Sea Level with
 1000 LB Fuel — Approach and Landing Reserve.

 With Over 3500 LB of Fuel Remaining, Fly at
 35000 FT at M 0.86 for Optimum Range.

 (A) Time & Fuel Included for a Penetration Descent
 at Destination. Range Does Not Include Distance
 for Descent at Destination.

 (B) Time & Fuel Included for a Maximum Range
 Descent at Destination. Range Includes Distance
 for On-Course Descent to Sea Level Destination.

 (C) Time & Fuel Included for Climb to Optimum Altitude
 and Penetration Descent at Destination. Range Does Not
 Include Distance for Descent at Destination.

 (D) Time & Fuel Included for Climb to Optimum Altitude
 and Maximum Range Descent at Destination. Range Includes
 Distance for On-Course Descent to Sea Level Destination.

*TOTAL FUEL ON BOARD LB	RANGE AND TIME REMAINING WITH 1000 LB RESERVE AT SL									PROCEDURE
	1000 FT	INITIAL ALTITUDE								
		SL	5	10	15	20	25	30	35	
1500	NAUT MI	30	26	23	20	16	12	8	-	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	5.2	5.6	5.7	6.2	6.3	6.3	6.4	-	
	NAUT MI	30	39	46	59	66	76	85	100	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	5.2	7.2	8.0	10.0	11.3	12.4	13.6	15.6	
	1000 FT	SL/5	5/15	10/20	15/25	20/25	25/30	30/35	-/35	OPTIMUM ALTITUDE
	NAUT MI	30	26	23	20	16	12	8	-	Use Optimum Altitude Until Over Base (C)
2000	MINUTES	5.2	5.6	5.7	6.2	6.3	6.3	6.4	-	
	NAUT MI	34	48	52	60	67	77	91	100	Use Optimum Altitude and Descend on Course (D)
	MINUTES	6.3	6.8	8.7	10.9	11.5	13.0	14.5	15.6	
	NAUT MI	59	58	59	59	60	61	64	64	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	10.6	11.3	11.6	12.0	12.3	12.8	13.3	13.9	
	NAUT MI	59	72	84	100	112	127	144	164	Cruise at Initial Altitude and Descend on Course (B)
3000	MINUTES	10.6	12.7	14.0	16.0	17.6	19.0	20.6	23.1	
	1000 FT	SL/25	5/30	10/35	15/35	20/35	25/35	30/35	35/35	OPTIMUM ALTITUDE
	NAUT MI	59	58	59	59	60	61	64	64	Use Optimum Altitude Until Over Base (C)
	MINUTES	10.6	11.3	11.6	12.0	12.3	12.8	13.3	13.9	
	NAUT MI	74	85	99	110	134	144	154	164	Use Optimum Altitude and Descend on Course (D)
	MINUTES	11.2	12.9	15.8	16.7	19.2	20.9	23.2	23.1	
4000	NAUT MI	119	125	133	141	153	164	179	191	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	21.6	22.8	22.9	23.8	25.0	25.7	27.0	28.4	
	NAUT MI	119	138	156	182	204	229	256	288	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	21.6	24.0	25.0	28.0	29.9	32.0	34.4	37.8	
	1000 FT	SL/35	25/35	30/35	30/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
	NAUT MI	119	126	142	148	168	175	186	191	Use Optimum Altitude Until Over Base (C)
5000	MINUTES	21.6	20.8	22.4	23.2	25.4	26.4	28.2	28.4	
	NAUT MI	196	214	236	248	260	273	284	289	Use Optimum Altitude and Descend on Course (D)
	MINUTES	28.8	29.0	30.4	32.4	34.2	35.4	37.4	37.8	
	NAUT MI	177	190	206	223	243	264	291	315	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	31.3	33.4	34.2	35.7	37.0	38.4	40.6	43.0	
	NAUT MI	177	208	234	261	296	333	374	414	Cruise at Initial Altitude and Descend on Course (B)
6000	MINUTES	31.3	35.1	36.6	39.8	42.2	44.7	47.7	52.4	
	1000 FT	35/35	35/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
	NAUT MI	224	235	257	268	282	296	308	315	Use Optimum Altitude Until Over Base (C)
	MINUTES	32.0	32.8	35.1	36.9	38.9	40.7	42.0	43.0	
	NAUT MI	320	333	351	366	376	392	408	414	Use Optimum Altitude and Descend on Course (D)
	MINUTES	41.2	42.0	44.5	46.4	48.2	50.0	51.6	52.4	
Cruise Altitude		SL	5	10	15	20	25	30	35	Cruise Speed
True Mach No		0.51	0.55	0.59	0.65	0.71	0.76	0.82	0.86	
DESCENT DIST NAUT MI -		8	16	24	33	41	51	61	MAX RANGE DESCENT	

Figure A4-5 (Sheet 4 of 4)

DIVERSION ENDURANCE SUMMARY TABLE



model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST

* SCHEDULES PROVIDE FOR ARRIVAL AT SEA LEVEL WITH 1000 LB FUEL APPROACH AND LANDING RESERVE.

[A] TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA LEVEL DESTINATION

[B] TIME & FUEL INCLUDED FOR A MILITARY THRUST CLIMB AT 0.88 TRUE MACH NUMBER TO OPTIMUM LOITER ALTITUDE.

TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA LEVEL DESTINATION.

*TOTAL FUEL ON BOARD LB	1000 FT	INITIAL ALTITUDE								PROCEDURE
		SL	5	10	15	20	25	30	35	
1500	MINUTES	7.9	9.8	11.3	13.0	14.3	15.7	16.9	18.1	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	15	20	25	30	30	35	35	35	
	MINUTES	8.5	10.3	11.8	13.3	14.5	15.9	16.9	18.1	
2000	MINUTES	15.7	18.0	19.9	22.0	23.6	25.3	26.6	28.0	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	35	35	35	35	35	35	35	35	
	MINUTES	18.1	20.0	21.8	23.2	24.5	25.8	27.0	28.0	
3000	MINUTES	30.9	34.1	36.8	39.6	41.9	44.1	45.7	47.4	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	35	35	35	35	35	35	35	35	
	MINUTES	37.5	39.4	41.0	42.5	43.9	45.1	46.3	47.4	
4000	MINUTES	45.8	49.6	53.3	56.7	59.6	62.3	64.2	66.1	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	35	35	35	35	35	35	35	35	
	MINUTES	56.2	58.3	59.9	61.5	62.8	64.0	65.0	66.1	

LOITER SPEEDS AND DESCENT DATA

LOITER ALT (1000 FT)	S.L.	5	10	15	20	25	30	35	
TRUE MACH NUMBER	0.40	0.43	0.47	0.53	0.58	0.65	0.73	0.81	
DESCENT DIST	-	9	19	28	39	49	61	74	NAUT MI
DESCENT TIME	-	2.2	4.2	5.8	7.8	9.4	11.2	13.0	MINUTES

Figure A4-6 (Sheet 1 of 4)

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST

DIVERSION ENDURANCE SUMMARY TABLE

CONFIGURATION
 DRAG INDEX ► 28



* SCHEDULES PROVIDE FOR ARRIVAL AT SEA LEVEL WITH 1000 LB
 FUEL APPROACH AND LANDING RESERVE.

[A] TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA
 LEVEL DESTINATION.

[B] TIME & FUEL INCLUDED FOR A MILITARY THRUST CLIMB AT 0.88
 TRUE MACH NUMBER TO OPTIMUM LOITER ALTITUDE.

TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA
 LEVEL DESTINATION.

*TOTAL FUEL ON BOARD LB	1000 FT	INITIAL ALTITUDE								PROCEDURE
		SL	5	10	15	20	25	30	35	
1500	MINUTES	7.4	9.1	10.7	12.0	13.4	14.7	16.0	17.1	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	S. L.	5	10	15	20	25	30	35	
	MINUTES	7.4	9.1	10.7	12.0	13.4	14.7	16.0	17.1	
2000	MINUTES	14.7	16.7	18.8	20.4	22.1	23.5	25.1	26.2	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	30	35	35	35	35	35	35	35	
	MINUTES	15.6	18.1	19.8	21.4	22.7	24.1	25.2	26.2	
3000	MINUTES	29.1	31.7	34.6	36.7	39.0	40.8	42.7	43.8	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	35	35	35	35	35	35	35	35	
	MINUTES	33.4	35.7	37.3	39.0	40.5	41.6	42.8	43.8	
4000	MINUTES	43.1	46.5	49.9	52.6	55.5	57.4	59.7	60.8	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	35	35	35	35	35	35	35	35	
	MINUTES	50.6	52.7	54.6	56.0	57.5	58.7	59.8	60.8	

LOITER SPEEDS AND DESCENT DATA

LOITER ALT (1000 FT)	S. L.	5	10	15	20	25	30	35	
TRUE MACH NUMBER	0.39	0.43	0.47	0.52	0.58	0.64	0.72	0.81	
DESCENT DIST	-	8	18	26	36	45	56	68	NAUT MI
DESCENT TIME	-	2.0	4.0	5.5	7.2	8.8	10.4	12.2	MINUTES

Figure A4-6 (Sheet 2 of 4)

DIVERSION ENDURANCE SUMMARY TABLE

CONFIGURATION
DRAG INDEX

52

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST

* SCHEDULES PROVIDE FOR ARRIVAL AT SEA LEVEL WITH 1000 LB
 FUEL APPROACH AND LANDING RESERVE.

Ⓐ TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA
 LEVEL DESTINATION.

Ⓑ TIME & FUEL INCLUDED FOR A MILITARY THRUST CLIMB AT 0.88
 TRUE MACH NUMBER TO OPTIMUM LOITER ALTITUDE.

TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA
 LEVEL DESTINATION.

*TOTAL FUEL ON BOARD LB	1000 FT	INITIAL ALTITUDE								PROCEDURE
		SL	5	10	15	20	25	30	35	
1500	MINUTES	7.1	8.7	10.1	11.6	13.0	14.1	15.4	16.6	LOITER AT INITIAL ALTITUDE Ⓐ OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE Ⓑ
	1000 FT	S.L.	5	10	15	20	25	30	35	
	MINUTES	7.1	8.7	10.1	11.6	13.0	14.1	15.4	16.6	
2000	MINUTES	14.2	16.0	17.8	19.6	21.3	22.6	24.1	25.3	LOITER AT INITIAL ALTITUDE Ⓐ OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE Ⓑ
	1000 FT	5	10	15	20	25	30	35	35	
	MINUTES	14.7	16.2	18.0	19.8	21.5	22.8	24.3	25.3	
3000	MINUTES	27.1	30.6	32.9	35.3	37.5	39.3	41.0	42.1	LOITER AT INITIAL ALTITUDE Ⓐ OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE Ⓑ
	1000 FT	35	35	35	35	35	35	35	35	
	MINUTES	30.5	32.7	34.9	36.9	38.5	39.7	41.0	42.1	
4000	MINUTES	41.4	45.0	47.6	50.5	53.3	55.3	57.0	58.3	LOITER AT INITIAL ALTITUDE Ⓐ OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE Ⓑ
	1000 FT	35	35	35	35	35	35	35	35	
	MINUTES	46.7	48.6	51.0	52.7	54.4	55.6	57.3	58.3	

LOITER SPEEDS AND DESCENT DATA

LOITER ALT (1000 FT)	S. L.	5	10	15	20	25	30	35	
TRUE MACH NUMBER	0.39	0.42	0.46	0.51	0.57	0.63	0.72	0.79	
DESCENT DIST	—	8	17	25	34	43	54	64	NAUT MI
DESCENT TIME	—	2.0	3.8	5.3	6.9	8.4	10.2	11.6	MINUTES

Figure A4-6 (Sheet 3 of 4)

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST

DIVERSION ENDURANCE SUMMARY TABLE

CONFIGURATION
 DRAG INDEX ► 72



*SCHEDULES PROVIDE FOR ARRIVAL AT SEA LEVEL WITH 1000 LB
 FUEL APPROACH AND LANDING RESERVE.

[A] TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA
 LEVEL DESTINATION.

[B] TIME & FUEL INCLUDED FOR A MILITARY THRUST CLIMB AT 0.88
 TRUE MACH NUMBER TO OPTIMUM LOITER ALTITUDE.

TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA
 LEVEL DESTINATION.

*TOTAL FUEL ON BOARD LB	1000 FT	INITIAL ALTITUDE								PROCEDURE
		SL	5	10	15	20	25	30	35	
1500	MINUTES	7.0	8.5	9.6	11.4	12.8	13.8	15.0	16.3	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	S. L.	5	10	15	20	25	30	35	
	MINUTES	7.0	8.5	9.6	11.4	12.8	13.8	15.0	16.3	
2000	MINUTES	14.0	15.6	17.0	19.1	20.6	22.2	23.4	24.8	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	S. L.	5	10	15	25	25	30	35	
	MINUTES	14.0	15.6	17.0	19.1	20.8	22.2	23.4	24.8	
3000	MINUTES	27.0	30.0	31.6	34.5	36.6	38.5	39.9	41.0	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	35	35	35	35	35	35	35	35	
	MINUTES	28.2	30.2	33.1	35.4	37.2	38.6	40.0	41.0	
4000	MINUTES	40.2	44.2	45.9	49.2	51.8	53.6	55.2	56.6	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	35	35	35	35	35	35	35	35	
	MINUTES	43.7	45.4	48.2	50.4	52.2	53.8	55.6	56.6	

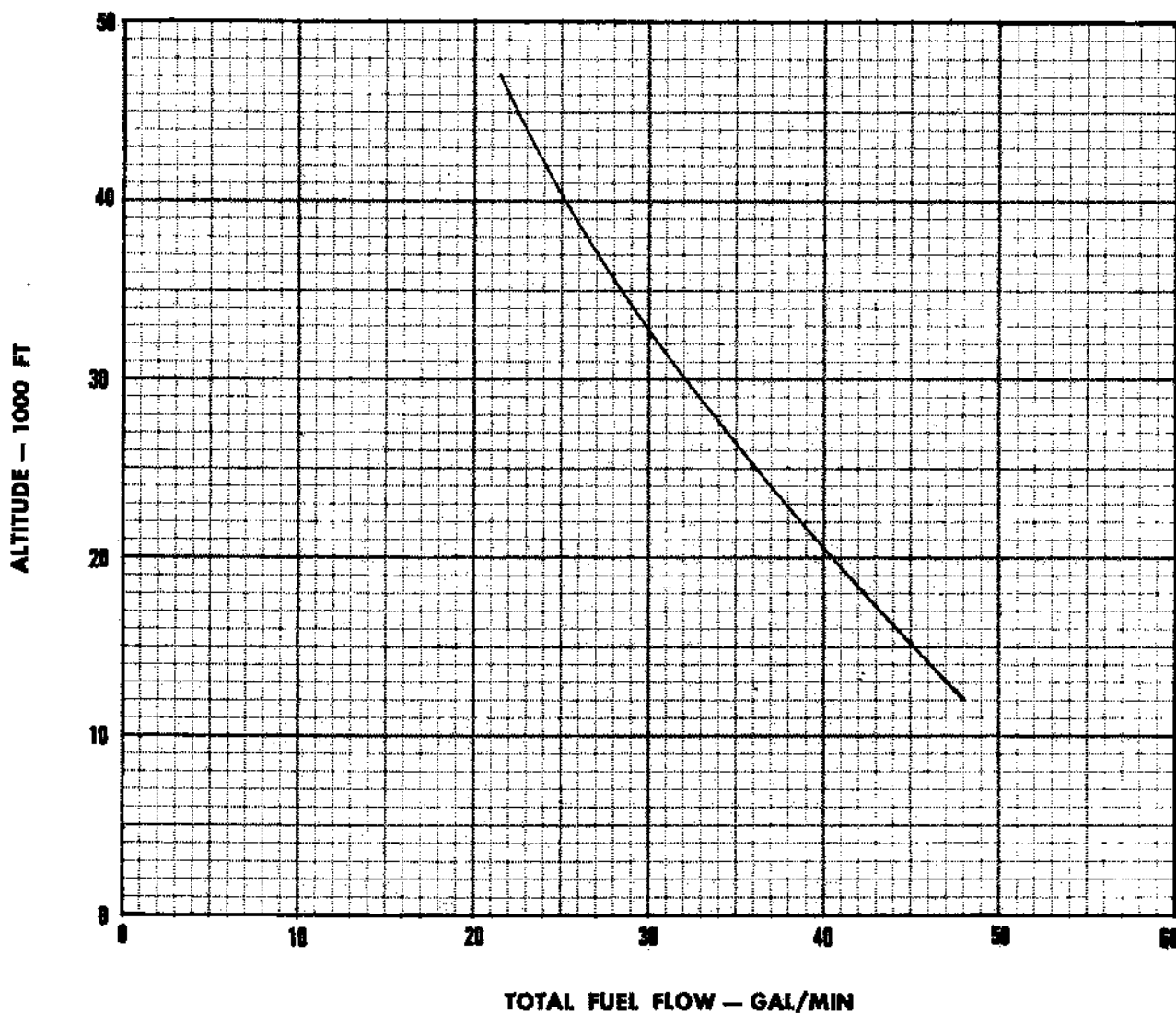
LOITER SPEEDS AND DESCENT DATA

LOITER ALT (1000 FT)	S. L.	5	10	15	20	25	30	35	
TRUE MACH NUMBER	0.38	0.42	0.46	0.51	0.57	0.63	0.72	0.79	
DESCENT DIST	—	8	16	24	33	41	51	61	NAUT MI
DESCENT TIME	—	2.0	3.6	5.1	6.7	8.1	9.7	11.2	MINUTES

Figure A4-6 (Sheet 4 of 4)

**TOTAL FUEL FLOW VS ALTITUDE
FOR EXTENDED AFTERBURNER
RANGE OPERATION****SPEED 250-260 KCAS
IG FLIGHT**

Model:	F-105D
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 FEB. 1963
data basis:	FLIGHT TEST

*Figure A4-7*

PART 5 ENDURANCE

TABLE OF CONTENTS

Maximum Endurance Information A5-1

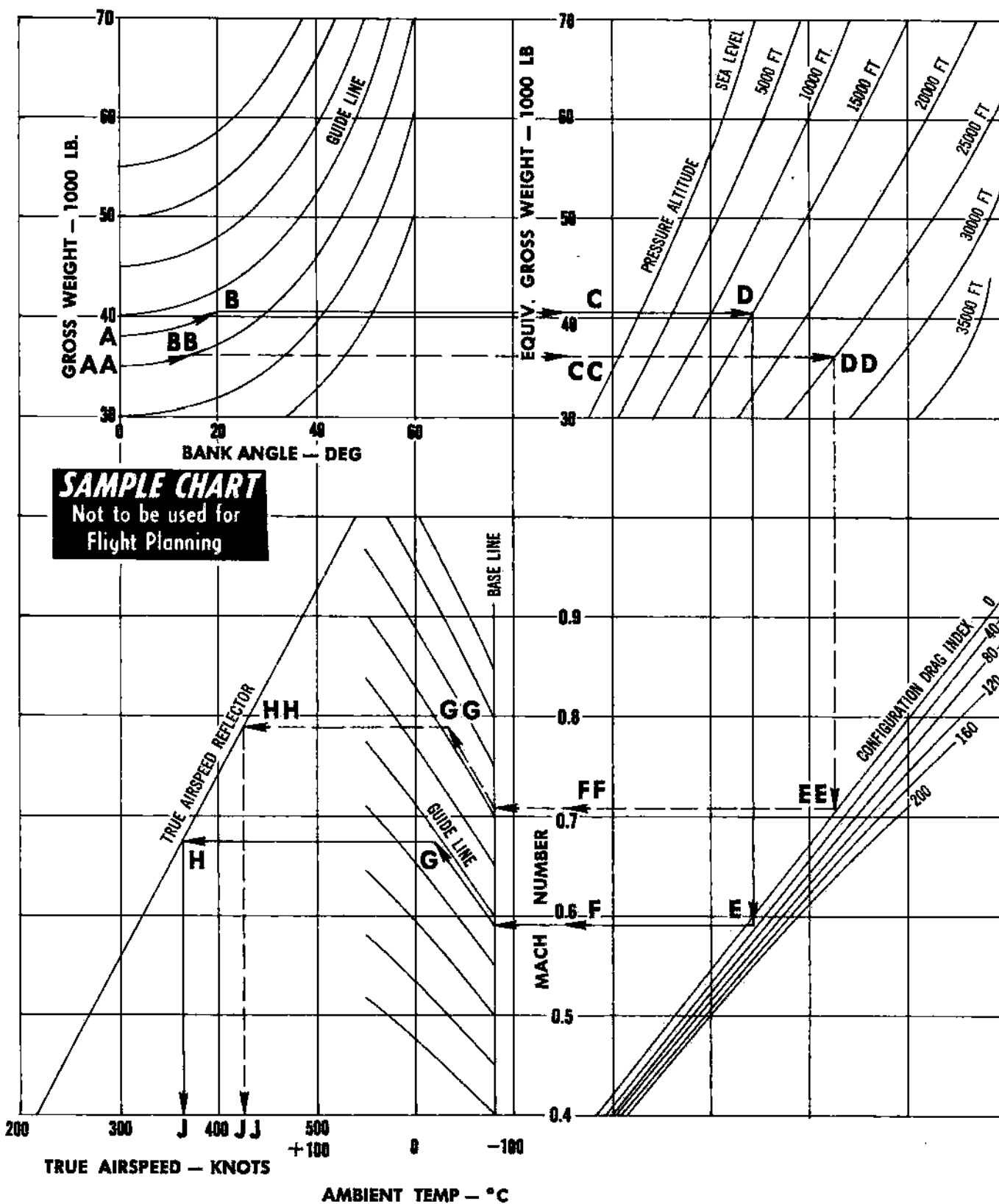
Maximum Endurance Charts A5-6

MAXIMUM ENDURANCE INFORMATION.

Charts in this part enable the pilot to determine maximum endurance speeds at any given conditions of Gross Weight, Altitude, Configuration Drag Index and constant bank angle, in addition to the fuel required for a specified loiter time or the loiter time available for a given fuel quantity.

**MAXIMUM ENDURANCE
MACH NUMBER AND TRUE AIRSPEED**

D



EXAMPLE I

Conditions: Configuration: Clean + (2) 450 gal tanks
 Initial Gross Weight: 41,000 lb
 Pressure Altitude: 15,000 ft
 Ambient Temperature: 6°C colder than standard day
 Bank Angle: 20°

Find: Mach number for Maximum Endurance and fuel used during 60 minutes.

Solution:

1. Determine the configuration drag index from the table on figure A1-5 by adding the various store drag numbers

Store	Location	Store Drag NO.
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb'd	14
Configuration Drag Index =		28

2. Determine standard day ambient temperature at 15,000 ft pressure altitude from Standard Atmosphere Table (figure A1-10) = -14.718°C.
 Ambient temperature = Standard -6° = -14.718-6.0 = -20.7°C

3. Estimate Average Gross Weight
 Initial Gross Weight = 41,000 lb
 Estimated Fuel Used for 60 minutes = 6000 lb
 Estimated Final Weight = 41,000-6000 = 35,000 lb
 Estimated Average
 Gross Weight = $\frac{41,000 + 35,000}{2} = 38,000$ lb

4. Enter sample chart page A5-2 at estimated average gross weight of 38,000 lb, (A) and follow guide lines to 20° bank angle, (B).
 Read equivalent gross weight = 40,400 lb at (C).

5. Move to the right to 15,000 ft altitude line, (D) and drop down to configuration drag index = 28, (E)

6. Move to the Mach number scale and read endurance Mach number = 0.591, (F).

7. Continue to base line and follow guide lines until the ambient temperature of -20.7°C is intersected at (G). Move to the left to true airspeed reflector, (H), and down to the scale to read true airspeed = 365 knots, (J).

8. Enter sample chart page A5-4 at equivalent gross weight = 40,400 lb, (K).
 Move to the right to 15,000 ft altitude line, (L) and drop down to configuration drag index = 28, (M).

9. Move to the right to true airspeed = 365 knots at (N). Move up to the 60 minute time line, (P) and across to the fuel used scale and read 4500 lb of fuel, (Q).

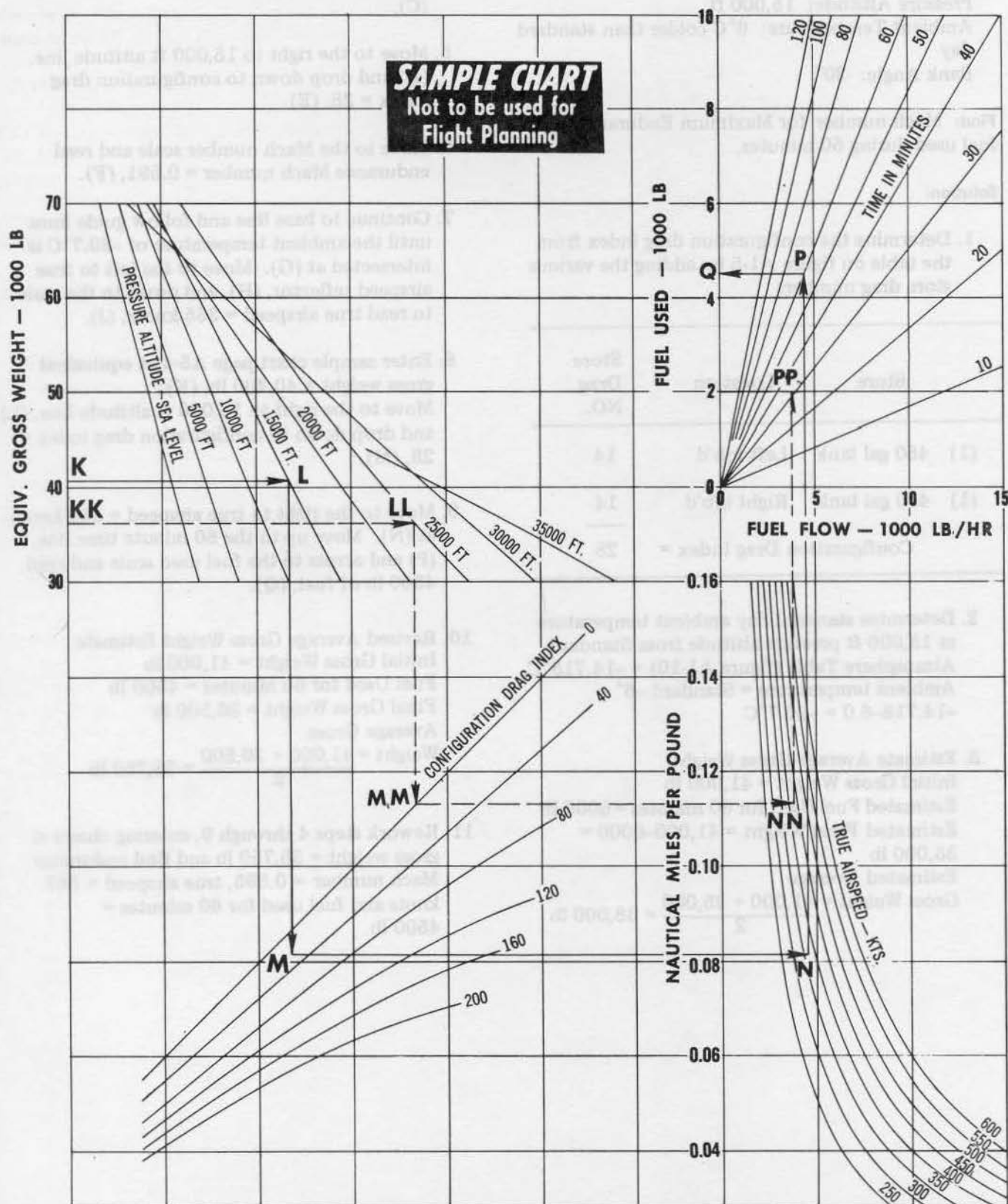
10. Revised Average Gross Weight Estimate
 Initial Gross Weight = 41,000 lb
 Fuel Used for 60 Minutes = 4500 lb
 Final Gross Weight = 36,500 lb
 Average Gross
 Weight = $\frac{41,000 + 36,500}{2} = 38,750$ lb

11. Rework steps 4 through 9, entering charts at gross weight = 38,750 lb and find endurance Mach number = 0.595, true airspeed = 367 knots and fuel used for 60 minutes = 4500 lb.

**MAXIMUM ENDURANCE CHART
FUEL FLOW AND FUEL REQUIRED**

D

SAMPLE CHART
Not to be used for
Flight Planning



EXAMPLE II**Conditions:** Configuration: Clean Aircraft

Initial Gross Weight = 36,000 lb

Pressure Altitude = 25,000 ft

Ambient Temperature = Standard Day

Bank Angle = 15°

Find: Maximum endurance time available for 2000 lb of fuel**Solution:**

1. Determine Standard Day ambient temperature at 25,000 ft pressure altitude from Standard Atmosphere Table (figure A1-10) = -34.53°C.
2. Determine Average Gross Weight
Initial Gross Weight = 36,000 lb
Fuel Used for Loiter = 2000 lb
Final Gross Weight = 34,000 lb

Average Gross

$$\text{Weight} = \frac{36,000 + 34,000}{2} = 35,000 \text{ lb}$$

3. Enter sample chart page A5-2 and follow path as in Example I from 35,000 lb. (AA) to bank angle = 15°, (BB), read equivalent gross weight = 36,200 (CC), continue to 25,000 ft altitude line, (DD) to configuration drag index = 0, (EE) to Mach number = 0.710, (FF), to ambient temperature of -34.5°C, (GG), to (HH), and read true airspeed = 427 knots, (JJ).
4. Enter sample chart page A5-4 and follow path as in Example I from 36,200 lb, (KK) to 25,000 ft altitude line, (LL) to configuration drag index = 0, (MM), to true airspeed = 427 knots, (NN).
5. Move up from (NN) to intersect the 2000 lb fuel line at (PP), and read time available = 32 minutes.

**MAXIMUM ENDURANCE
MACH NUMBER AND TRUE AIRSPEED**


model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST

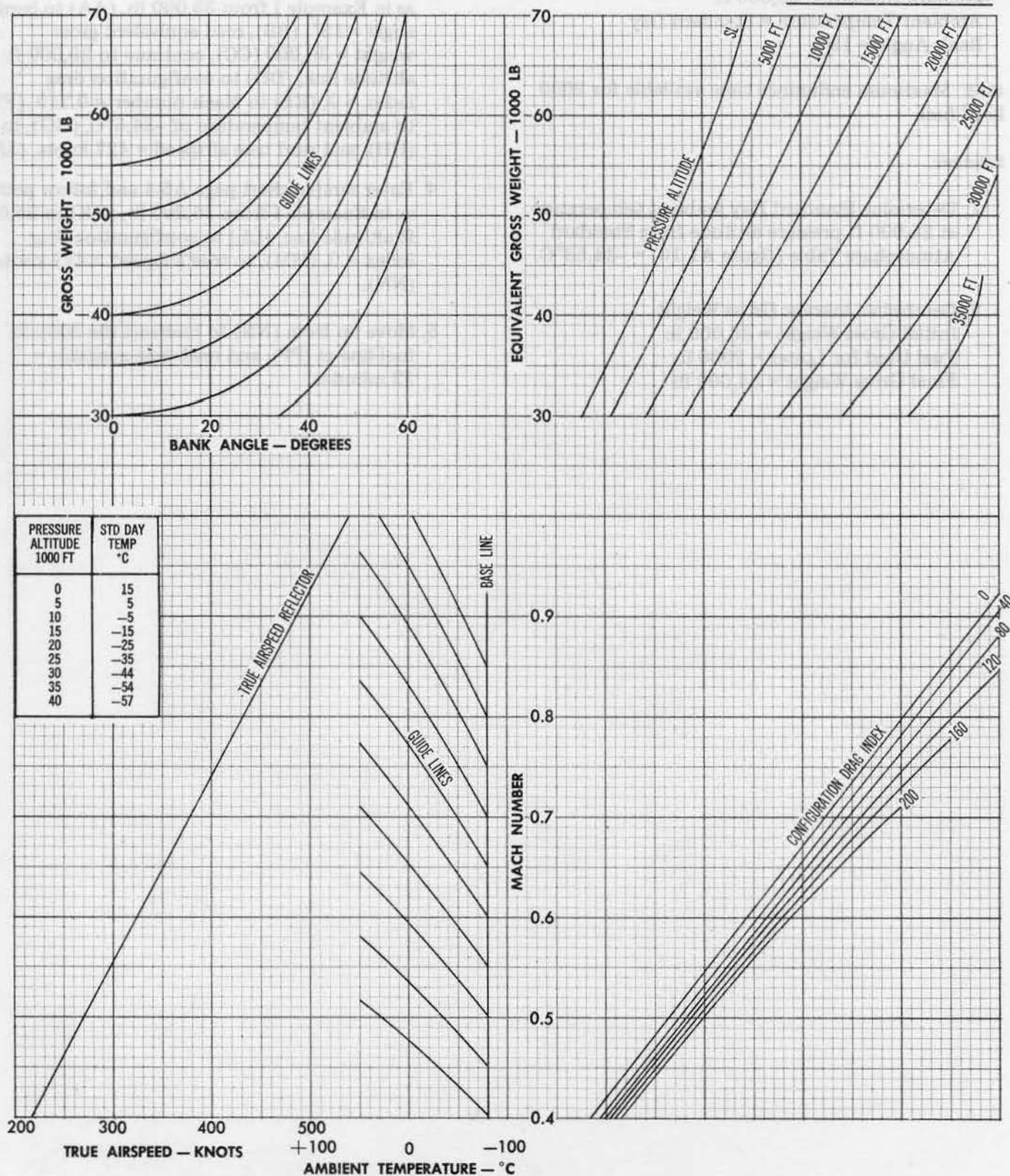


Figure A5-1 (Sheet 1 of 2)

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST



MAXIMUM ENDURANCE FUEL FLOW AND FUEL REQUIRED

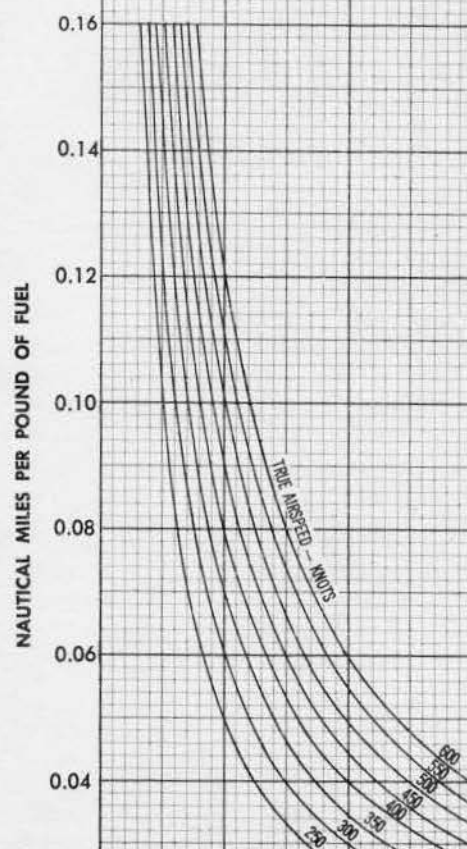
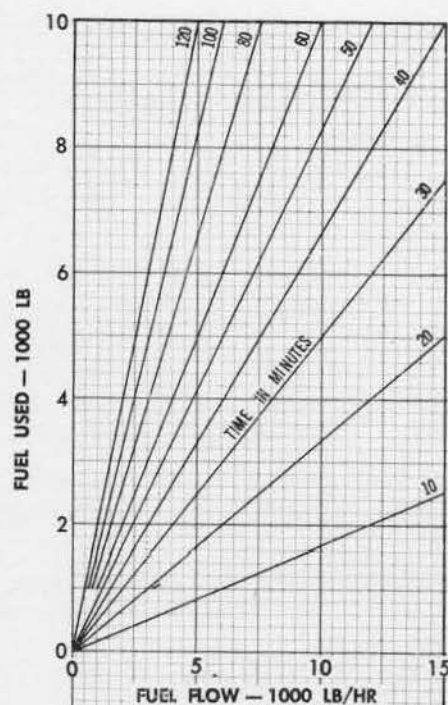
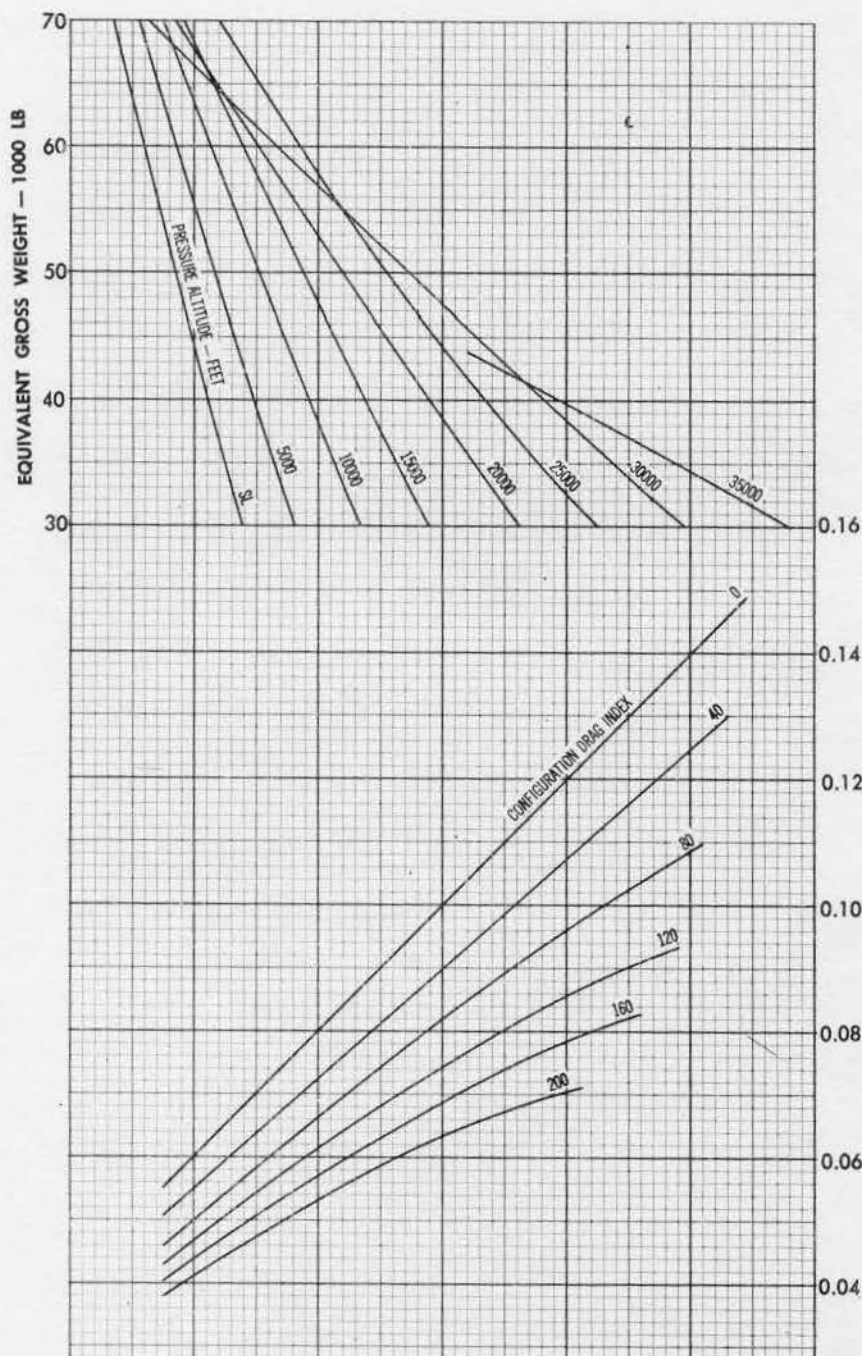


Figure A5-1 (Sheet 2 of 2)

PART 5A LEVEL FLIGHT ACCELERATION

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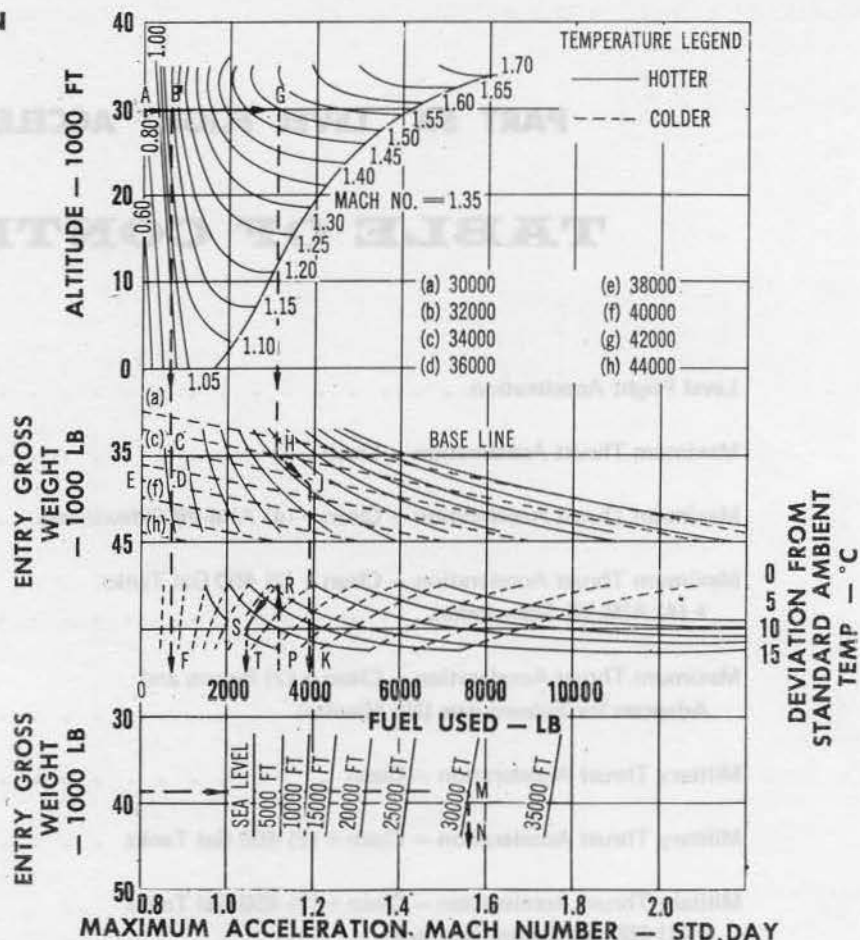
Level Flight Acceleration	A5A-3, A5A-5
Maximum Thrust Acceleration — Clean	A5A-8
Maximum Thrust Acceleration — Clean + (4) AIM-9B Sidewinders	A5A-11
Maximum Thrust Acceleration — Clean + (2) 450 Gal Tanks + (4) AIM-9B Sidewinders	A5A-14
Maximum Thrust Acceleration — Clean + (2) Pylons and Adapters for Sidewinders (No Missiles)	A5A-17
Military Thrust Acceleration — Clean	A5A-20
Military Thrust Acceleration — Clean + (2) 450 Gal Tanks	A5A-23
Military Thrust Acceleration — Clean + (2) 450 Gal Tanks + (1) 650 Gal Centerline Tank	A5A-26

MAXIMUM THRUST ACCELERATION

D

SAMPLE CHART

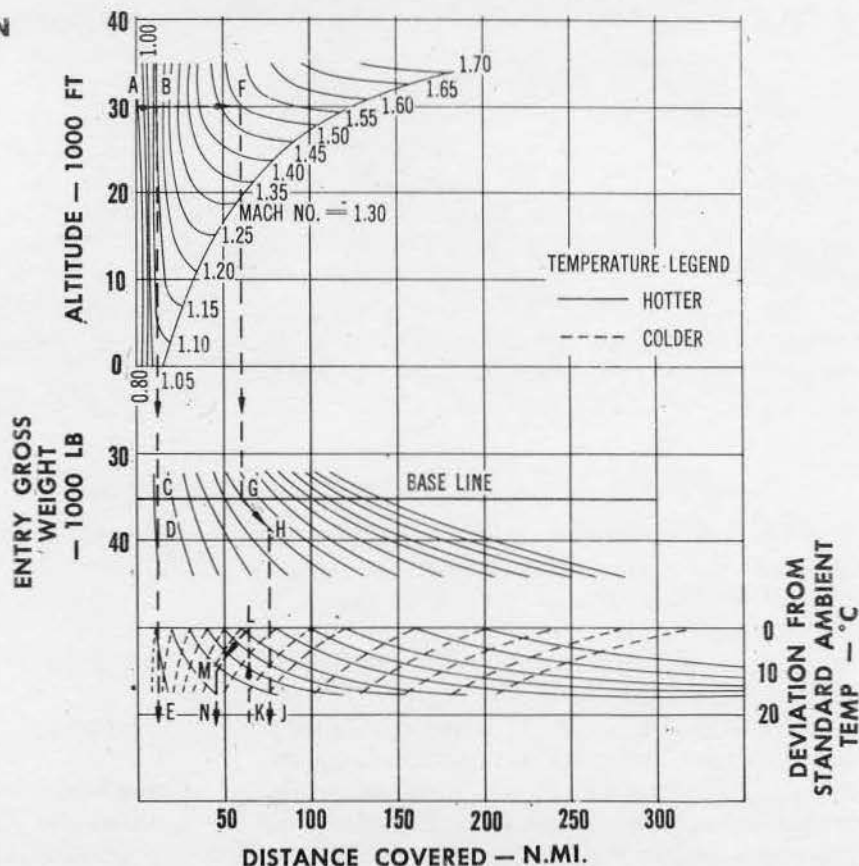
Not to be used for
Flight Planning



MAXIMUM THRUST ACCELERATION

SAMPLE CHART

Not to be used for
Flight Planning



MAXIMUM THRUST ACCELERATION

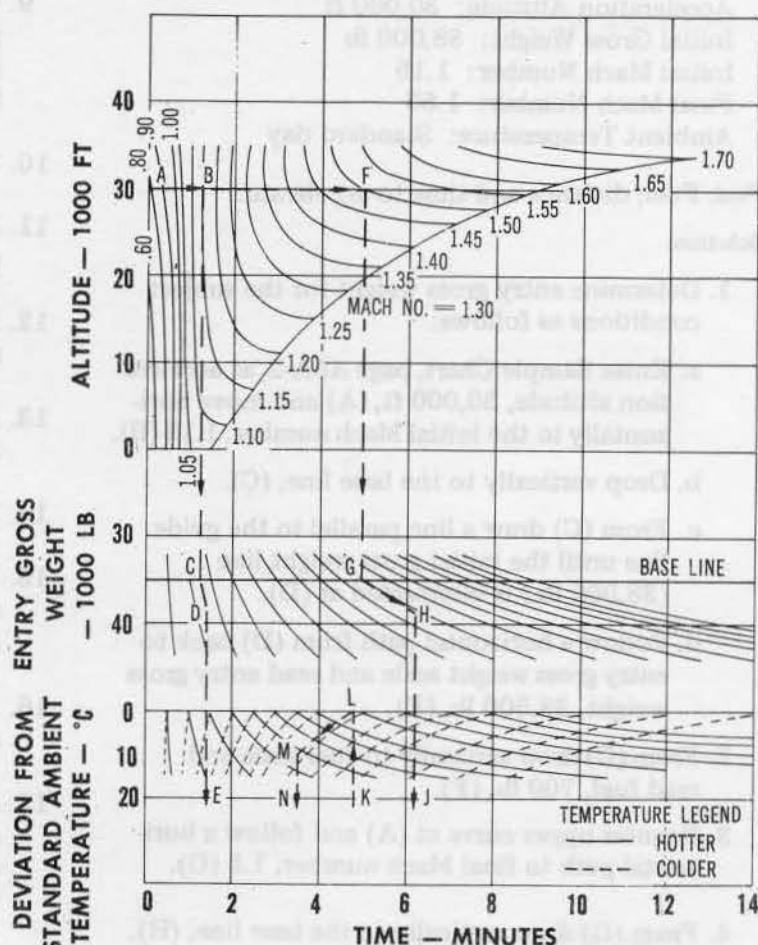
D**SAMPLE CHART**Not to be used for
Flight Planning

LEVEL FLIGHT ACCELERATION.

Maximum Thrust Acceleration Charts are provided for four configurations. (1) Clean, (2) Clean + (4) AIM-9B sidewinder missiles, (3) Clean + (2) 450 gallon tanks + (4) AIM-9B sidewinder missiles and (4) Clean + (2) pylons + adapters for sidewinders. Fuel used, distance covered and time elapsed can be read for a maximum thrust level flight acceleration for any combination of altitude, weight, Mach number and ambient temperature conditions. In addition, maximum acceleration Mach number for standard day conditions is shown.

Use:

To obtain fuel, distance and time to accelerate at a constant altitude, an entry gross weight for a set of initial conditions must be read from the fuel chart. Once entry gross weight has been determined fuel, distance and time can be read from these charts as described in Examples I and II. However, it should be noted that the final speed required may exceed maximum acceleration conditions for the aircraft. Therefore, a maximum acceleration Mach number is read to verify the capability of any desired acceleration. For standard day conditions,



the maximum acceleration Mach number can be read directly from the lower portion of the fuel chart. For non-standard temperature conditions, the final acceleration gross weight must be determined so that the maximum acceleration Mach number can be read from the Maximum Thrust Combat Allowance Chart.

Examples I and II show the procedure for reading these acceleration Charts according to the following general pattern:

1. Determine entry gross weight.
2. Find fuel used during the acceleration.
3. Read maximum acceleration Mach number.
4. Find distance covered during the acceleration.
5. Find time elapsed during the acceleration.

EXAMPLE I

Conditions: Configuration: Clean + (4) AIM-9B sidewinder missiles.

Acceleration Thrust Setting: Maximum

Acceleration Altitude: 30,000 ft
 Initial Gross Weight: 38,000 lb
 Initial Mach Number: 1.15
 Final Mach Number: 1.50
 Ambient Temperature: Standard day

Find: Fuel, distance and time to accelerate.

Solution:

1. Determine entry gross weight for the subject conditions as follows:
 - a. Enter Sample Chart, page A5A-2, at acceleration altitude, 30,000 ft, (A) and move horizontally to the initial Mach number, 1.15 (B).
 - b. Drop vertically to the base line, (C).
 - c. From (C) draw a line parallel to the guide line until the initial gross weight line (38,000 lb.) is intersected at (D).
 - d. Follow a horizontal path from (D) back to entry gross weight scale and read entry gross weight, 38,500 lb, (E).
2. From (D) drop vertically to fuel scale and read fuel, 700 lb, (F).
3. Reenter upper curve at (A) and follow a horizontal path to final Mach number, 1.5 (G).
4. From (G) drop vertically to the base line, (H).
5. From (H) draw a line parallel to the guide line stopping at the *entry gross weight*, 38,500 lb (J).
6. From (J) drop vertically to the fuel scale and read fuel, 3900 lb (K).
7. Fuel used to accelerate is equal to the difference between the two fuel readings at (K) and (F) or $(3900 - 700 = 3200 \text{ lb})$.
8. At this point check that the final Mach number does not exceed maximum acceleration Mach number by the method shown below:
 - a. Enter Maximum Acceleration Mach Number Curve at bottom of page A5A-2 at entry gross weight, 38,500 lb, (L) and move horizontally to the 30,000 ft acceleration altitude line, (M).
 - b. Drop vertically to Mach scale and read maximum acceleration Mach number, 1.562 (N).

9. To read distance covered, enter Sample Curve, page A5A-2, at acceleration altitude, 30,000 ft (A) and move horizontally to initial Mach number, 1.15 (B).

10. Drop vertically to base line, (C).

11. From (C) draw a line parallel to guide line stopping at entry gross weight, 38,500 lb at (D).

12. From (D) drop vertically to distance scale and read distance covered, 12 NMi (E).

13. Reenter upper curve at (A) and follow a horizontal path to final Mach number, 1.5 (F).

14. From (F) drop vertically to the base line, (G).

15. From (G) draw a line parallel to the guide line stopping at the entry gross weight, 38,500 lb, (H).

16. From (H) drop vertically to the distance scale and read distance covered, 76 NMi, (J).

17. Distance covered during the acceleration is equal to the difference between the two distance readings at (J) and (E) or $(76 - 12 = 64 \text{ NMi})$.

18. Time to accelerate is read from Sample Curve, page A5A-3, using the same procedure as outlined in steps 9 through 17. Time to accelerate is equal to the difference between the two time readings at (J) and (E) or $(6.2 - 1.4 = 4.8 \text{ Min})$.

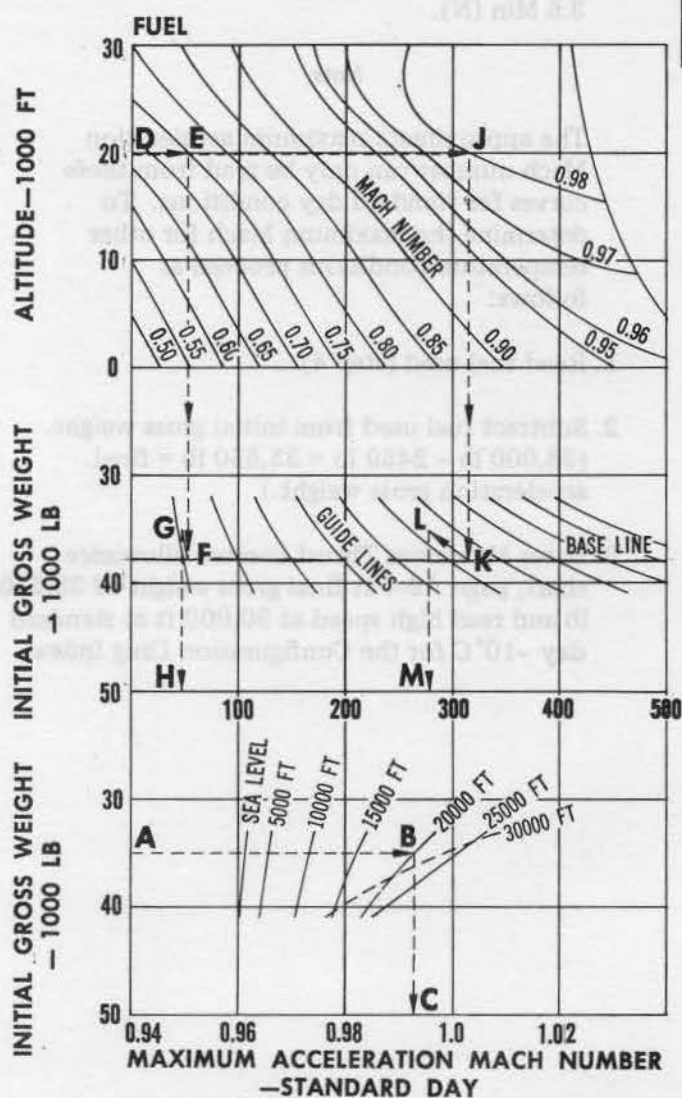
EXAMPLE II

Conditions: Same as Example I except that Ambient Temperature is 10°C colder than standard day.

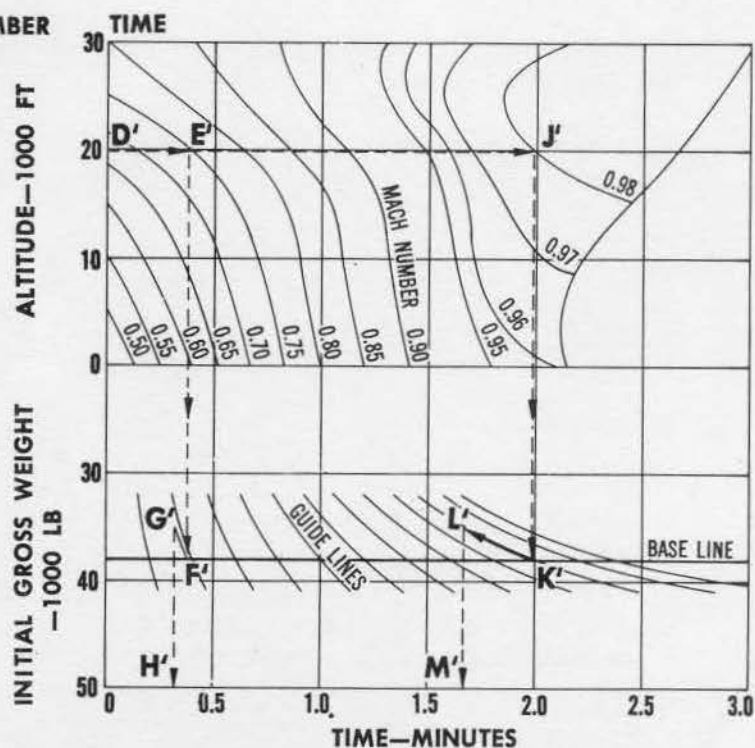
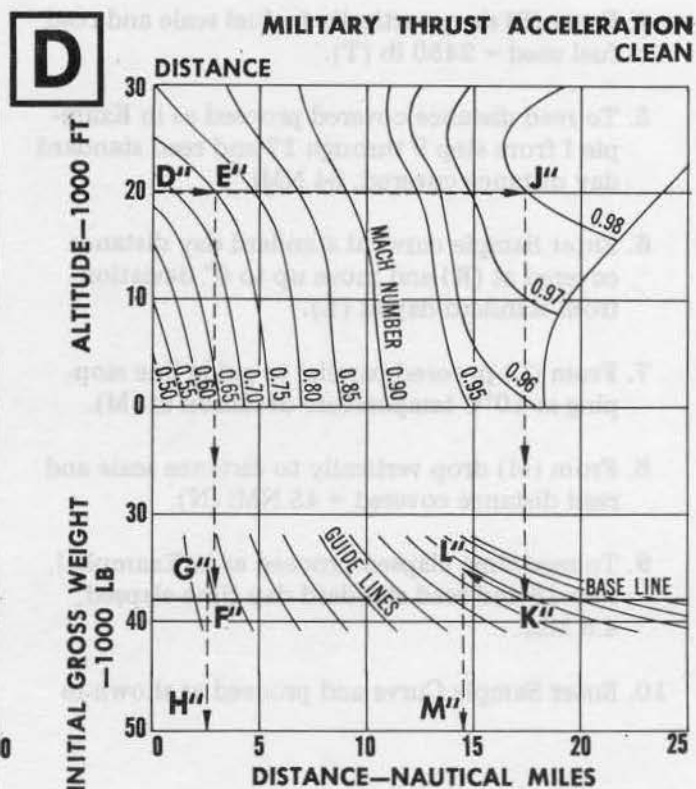
Find: Fuel, distance and time to accelerate.

Solution:

1. Proceed as shown in Example I for steps 1 through 7 to determine fuel used for standard day, 3200 lb.
2. Enter Temperature Curve at standard day fuel used at 3200 lb, (P) and move up to 0° Deviation from standard day at (R).
3. From (R) proceed parallel to colder guide line stopping at 10°C temperature deviation, (S).



SAMPLE CHART
Not to be used for Flight Planning



4. From (S) drop vertically to fuel scale and read fuel used = 2450 lb (T).
5. To read distance covered proceed as in Example I from step 9 through 17 and read standard day distance covered, 64 NMi.
6. Enter Sample curve at standard day distance covered at (K) and move up to 0° deviation from standard day at (L).
7. From (L) proceed parallel to guide line stopping at 10°C temperature deviation at (M).
8. From (M) drop vertically to distance scale and read distance covered = 45 NMi (N).
9. To read time elapsed proceed as in Example I, step 18 and read standard day time elapsed, 4.8 Min.
10. Enter Sample Curve and proceed as shown in

steps 6 through 8 and read time elapsed = 3.5 Min (N).

Note

The approximate maximum acceleration Mach number can only be read from these curves for standard day conditions. To determine the maximum Mach for other temperature conditions proceed as follows:

1. Read fuel used (step 4).
2. Subtract fuel used from initial gross weight.
(38,000 lb - 2450 lb = 35,550 lb = final acceleration gross weight.)
3. Enter Maximum Thrust combat allowance chart, page A9-4 at final gross weight of 35,550 lb and read high speed at 30,000 ft at standard day -10°C for the Configuration Drag Index.

LEVEL FLIGHT ACCELERATION – MILITARY THRUST

DESCRIPTION:

Military Thrust acceleration charts are provided for three configurations: 1) Clean aircraft, 2) Clean + (2) 450 gallon tanks (inboard), and 3) Clean + centerline 650 gallon tank + (2) 450 gallon tanks (inboard). Fuel used, distance covered and time elapsed can be read for Military Thrust level flight acceleration for any combination of altitude, gross weight and Mach number under standard day conditions, as well as maximum acceleration Mach number.

USE:

Fuel, distance, and time are obtained by the same method. Fuel is determined in the example below. It should be noted that the final speed required should be checked against the maximum acceleration Mach number to verify the aircraft's capability to perform the desired acceleration with Military Thrust.

EXAMPLE:

Conditions:

Configuration:	Clean
Acceleration Thrust Setting:	Military
Acceleration Altitude:	20,000 ft
Initial Gross Weight:	35,000 lb
Initial Mach Number:	0.75
Final Mach Number:	0.98

Find: Fuel, distance, and time to accelerate.

Solution:

1. Determine that the final Mach number does not exceed the maximum acceleration Mach number. Enter the Maximum Acceleration Mach Number Curve at the top left of page A5A-4A at the initial gross weight, 35,000 lb.

(A) move horizontally to the 20,000 ft acceleration altitude line. (B) and drop vertically to the Mach No. scale to read maximum acceleration Mach number = 0.993. (C). Since the required final Mach number (0.98) is within the aircraft's Military Thrust Acceleration capability, continue.

2. Find fuel used:

- (a) Enter Sample Chart, top left on page A5A-3, at acceleration altitude 20,000 ft. (D): move horizontally to the initial Mach number = 0.75. (E) and drop vertically to the base line. (F).
- (b) From (F) draw a line parallel to the guide line until the initial gross weight is intersected at (G), drop vertically to the fuel scale and read fuel = 47 lb. (H).
- (c) Re-enter chart at (D) and follow a horizontal path to final Mach number = 0.98. (J) drop vertically to the baseline. (K). Draw a line parallel to the guide line until the initial gross weight is intersected at (L) and drop vertically to the fuel scale to read fuel = 278 lb. (M).
- (d) Fuel used to accelerate is equal to the difference between the two fuel readings at (M) and (H), or $(278 - 47 = 231 \text{ lb})$.

3. Distance covered and time elapsed during the acceleration are obtained by using the same procedure as outlined in steps 2a through 2d. The distance and time sample charts are found on page A5A-4. The time to accelerate is equal to the difference between (M') and (H') or $(1.67 - 0.32) = 1.35 \text{ min}$. The distance covered in the acceleration is equal to the difference between (M'') and (H''), or $(14.50 - 2.55) = 11.95 \text{ NMI}$.



MAXIMUM THRUST ACCELERATION CLEAN

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

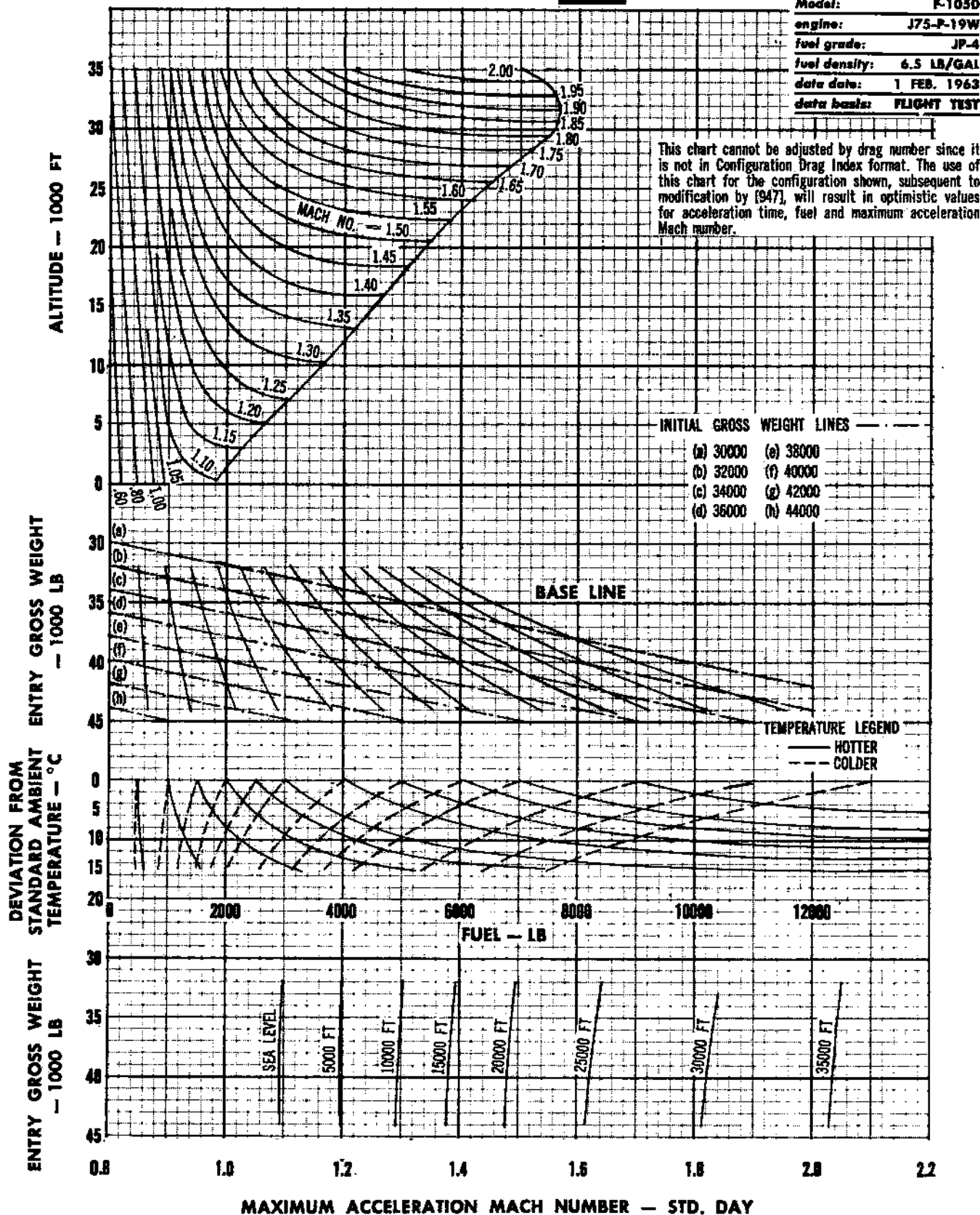


Figure A5A-1 (Sheet 1 of 3)

MAXIMUM THRUST ACCELERATION CLEAN

D

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

Model:	F-105D
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 FEB. 1963
data basis:	FLIGHT TEST

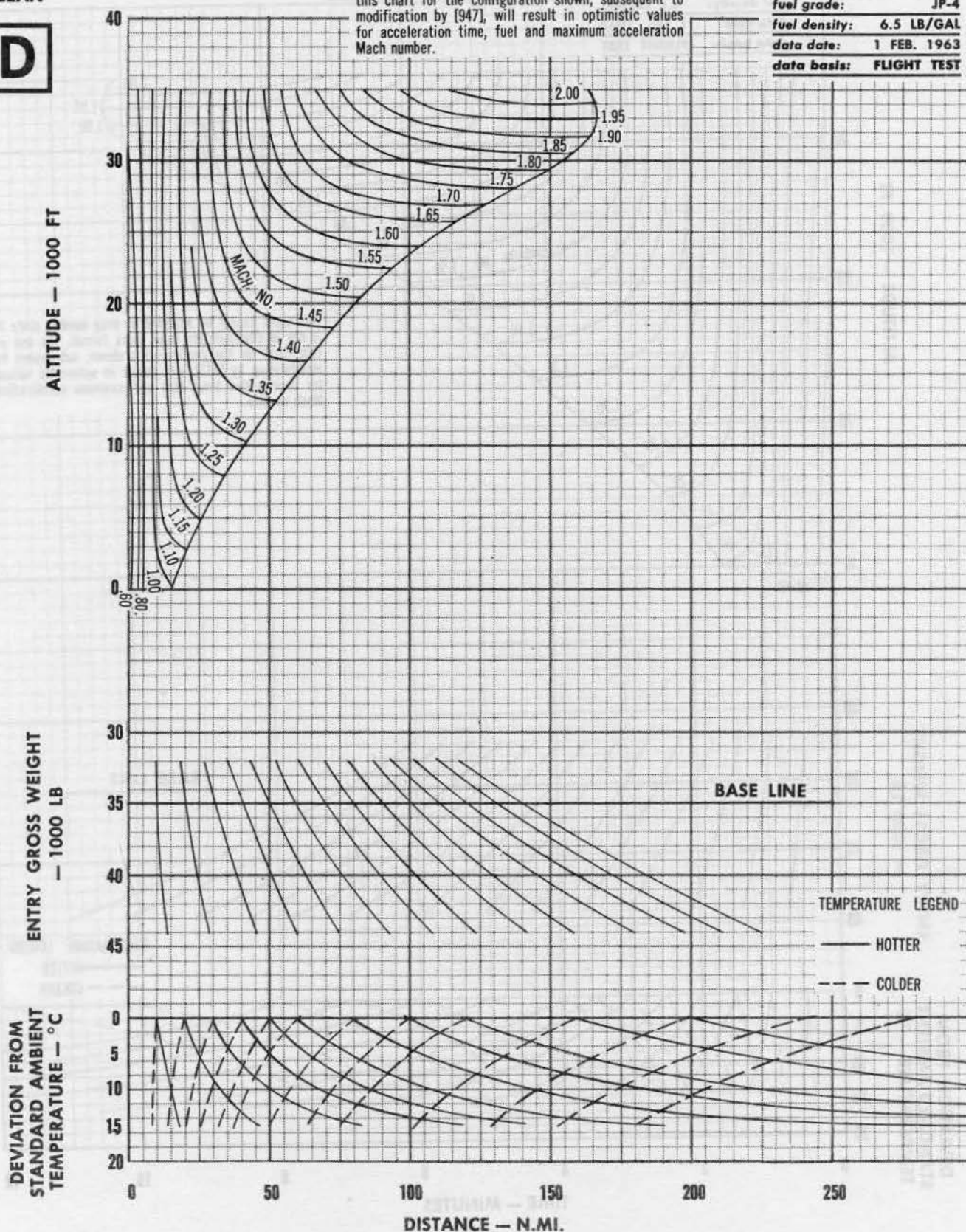


Figure A5A-1 (Sheet 2 of 3)

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST



MAXIMUM THRUST ACCELERATION CLEAN

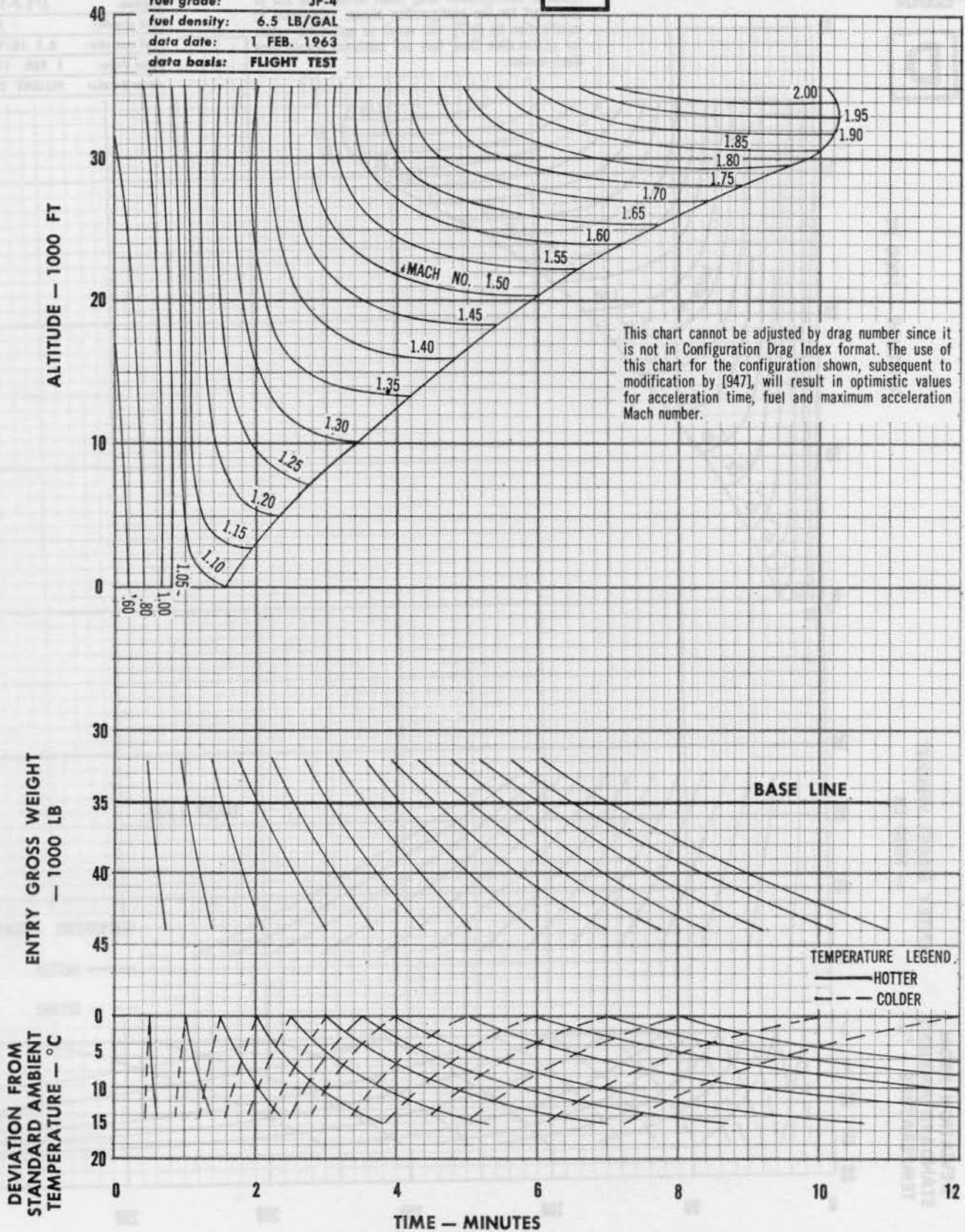


Figure A5A-1 (Sheet 3 of 3)

**MAXIMUM THRUST ACCELERATION
CLEAN + (4) AIM - 9B SIDEWINDERS**
D

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

Model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB. 1963
data basis: FLIGHT TEST

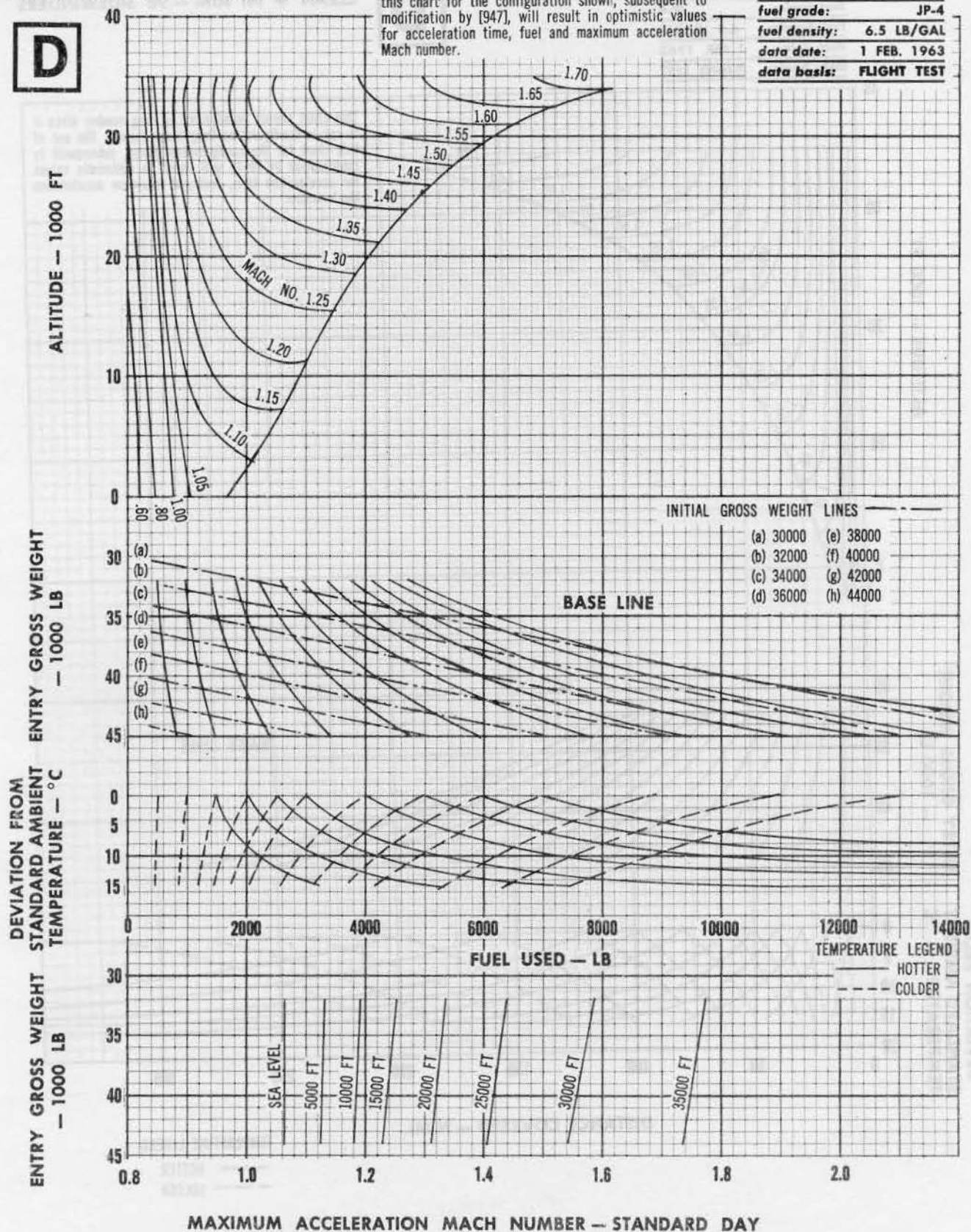


Figure A5A-2 (Sheet 1 of 3)

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

MAXIMUM THRUST ACCELERATION **CLEAN + (4) AIM - 9B SIDEWINDERS**

D

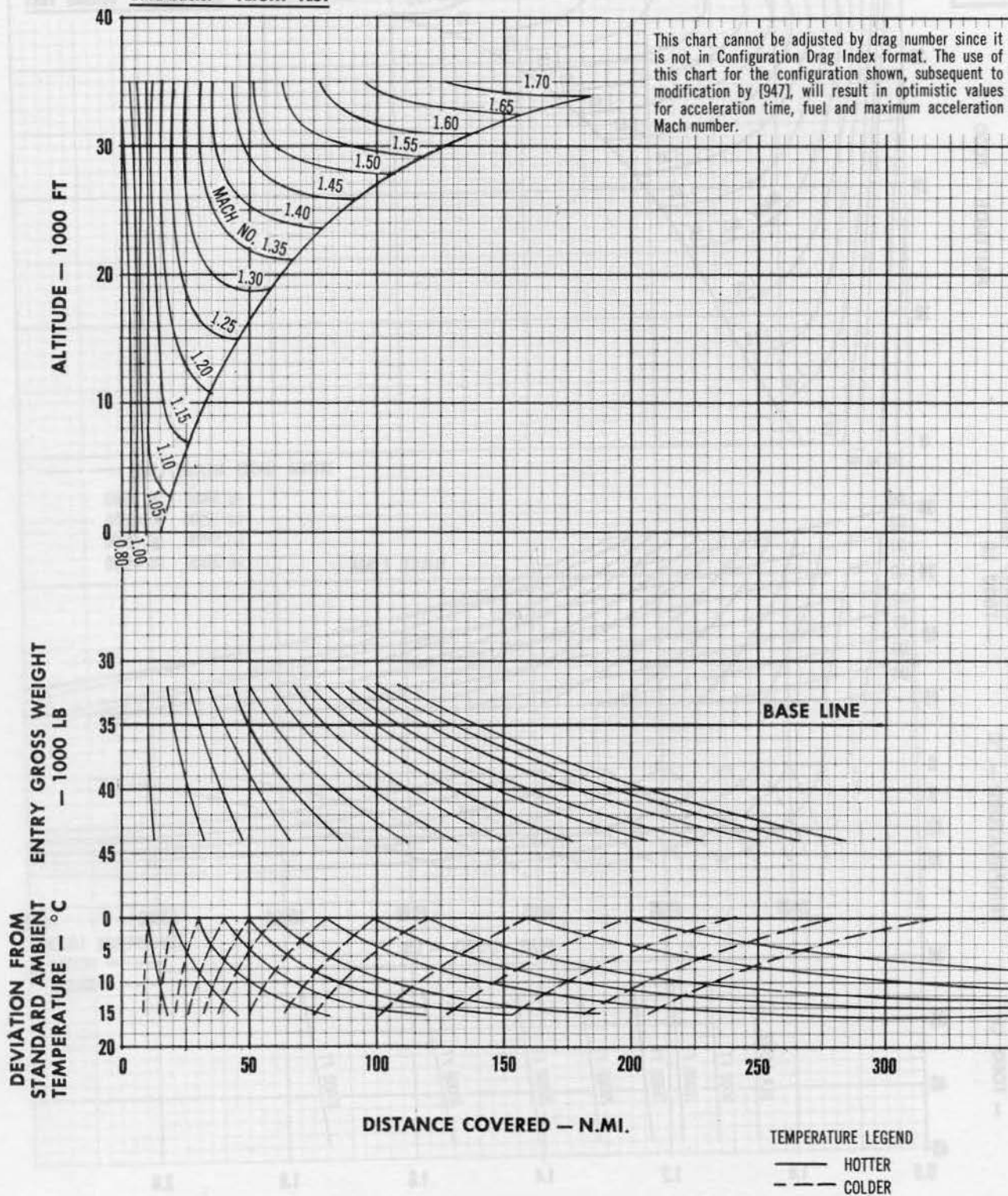


Figure A5A-2 (Sheet 2 of 3)

**MAXIMUM THRUST ACCELERATION
CLEAN + (4) AIM - 9B SIDEWINDERS**
D

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

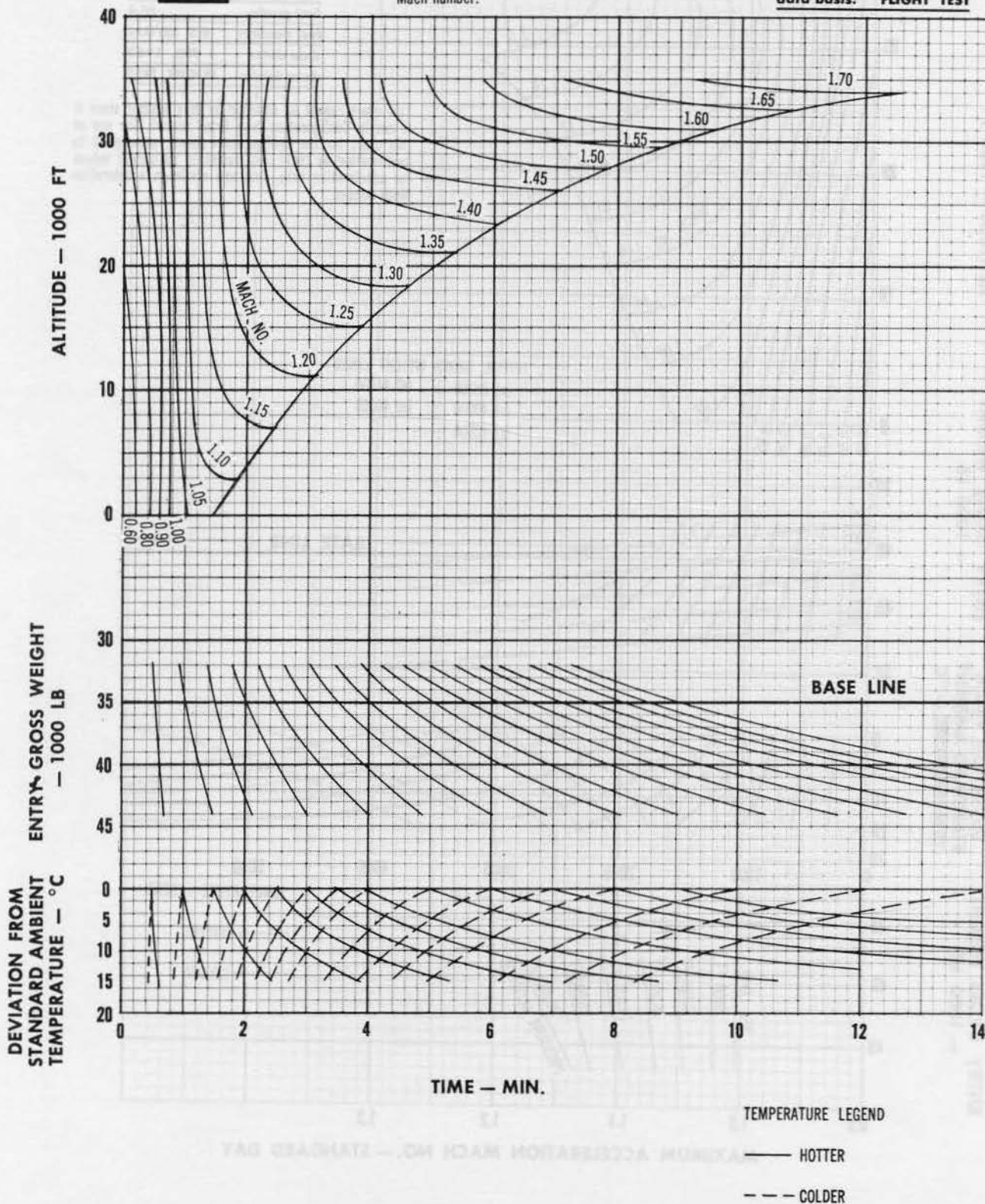


Figure A5A-2 (Sheet 3 of 3)

ALTITUDE — 1000 FT

ENTRY GROSS WEIGHT
— 1000 LBDEVIATION FROM
STANDARD AMBIENT
TEMPERATURE — °CENTRY GROSS WEIGHT
— 1000 LB**MAXIMUM THRUST ACCELERATION****CLEAN + (2) 450 GAL TANKS +
(4) AIM — 9B SIDEWINDERS**

Model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB. 1963
data basis: FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

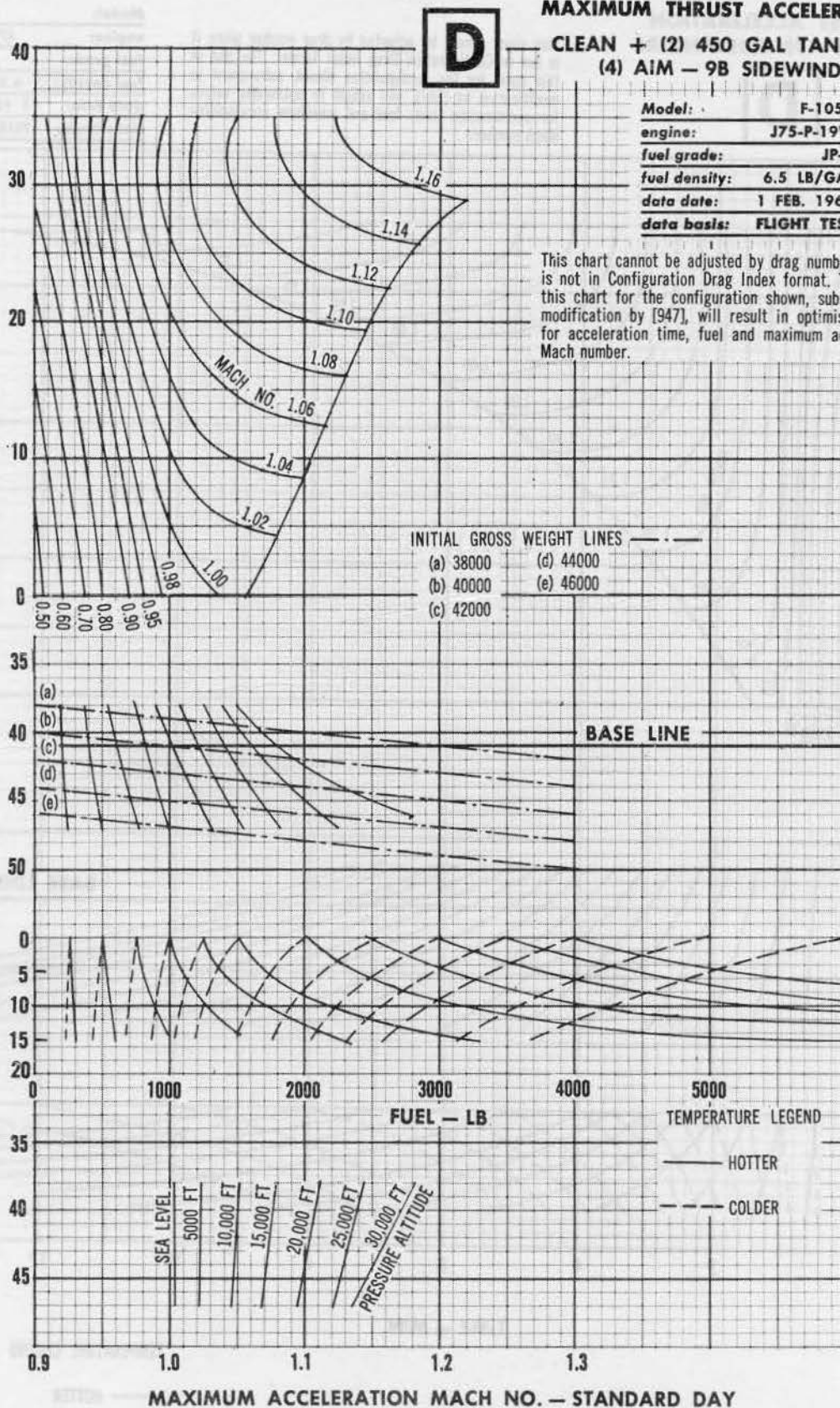


Figure A5A-3 (Sheet 1 of 3)

MAXIMUM THRUST ACCELERATION

**CLEAN + (2) 450 GAL TANKS +
(4) AIM - 9B SIDEWINDERS**

D

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

Model:	F-105D
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 FEB. 1963
data basis:	FLIGHT TEST

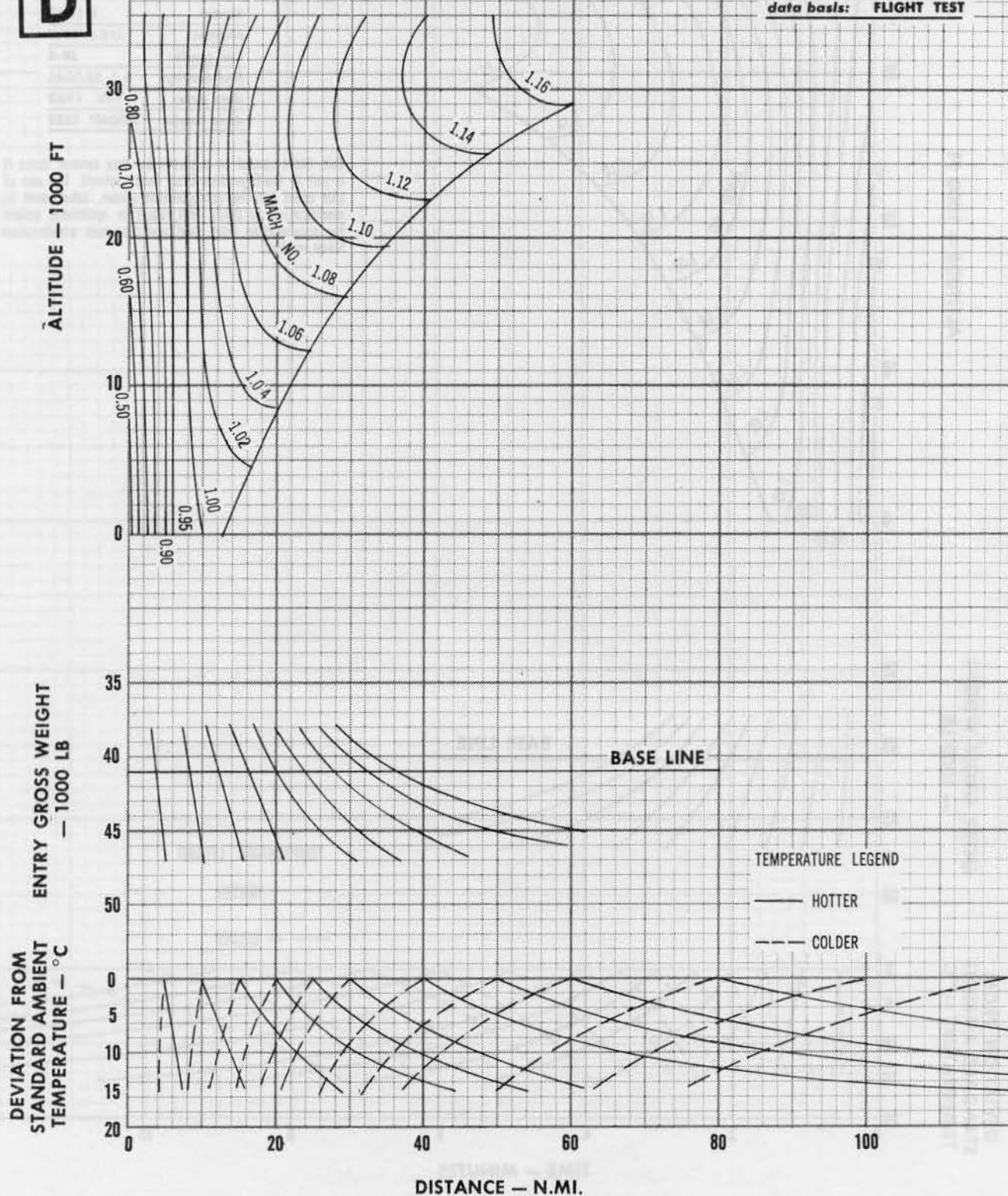


Figure A5A-3 (Sheet 2 of 3)

D**MAXIMUM THRUST ACCELERATION****CLEAN + (2) 450 GAL TANKS +
(4) AIM - 9B SIDEWINDERS**

Model:	F-105D
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 FEB. 1963
data basis:	FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

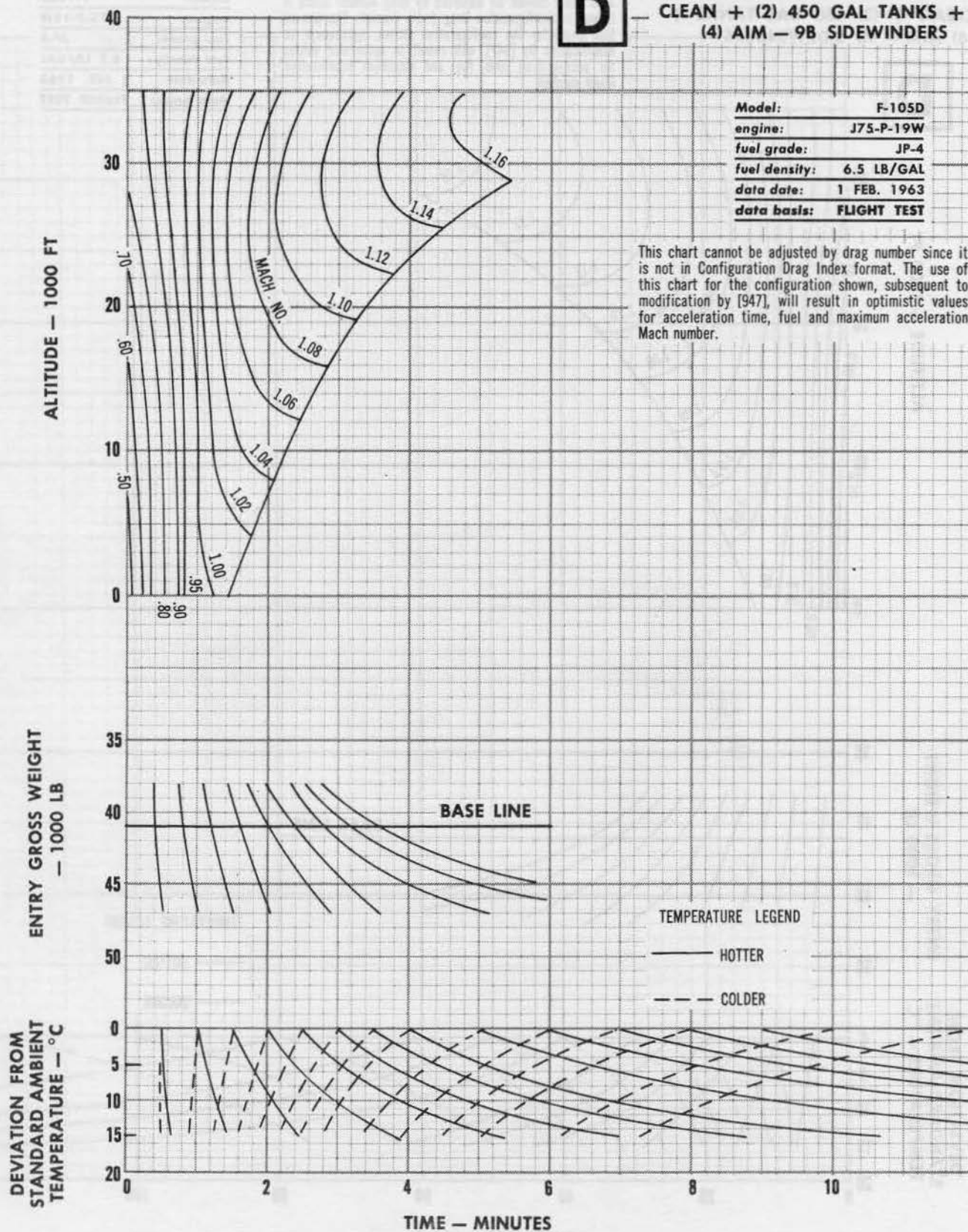


Figure A5A-3 (Sheet 3 of 3)

**MAXIMUM THRUST ACCELERATION
CLEAN + (2) PYLONS AND ADAPTERS
FOR SIDEWINDERS (NO MISSILES)**

D

Model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB. 1963
data basis: FLIGHT TEST

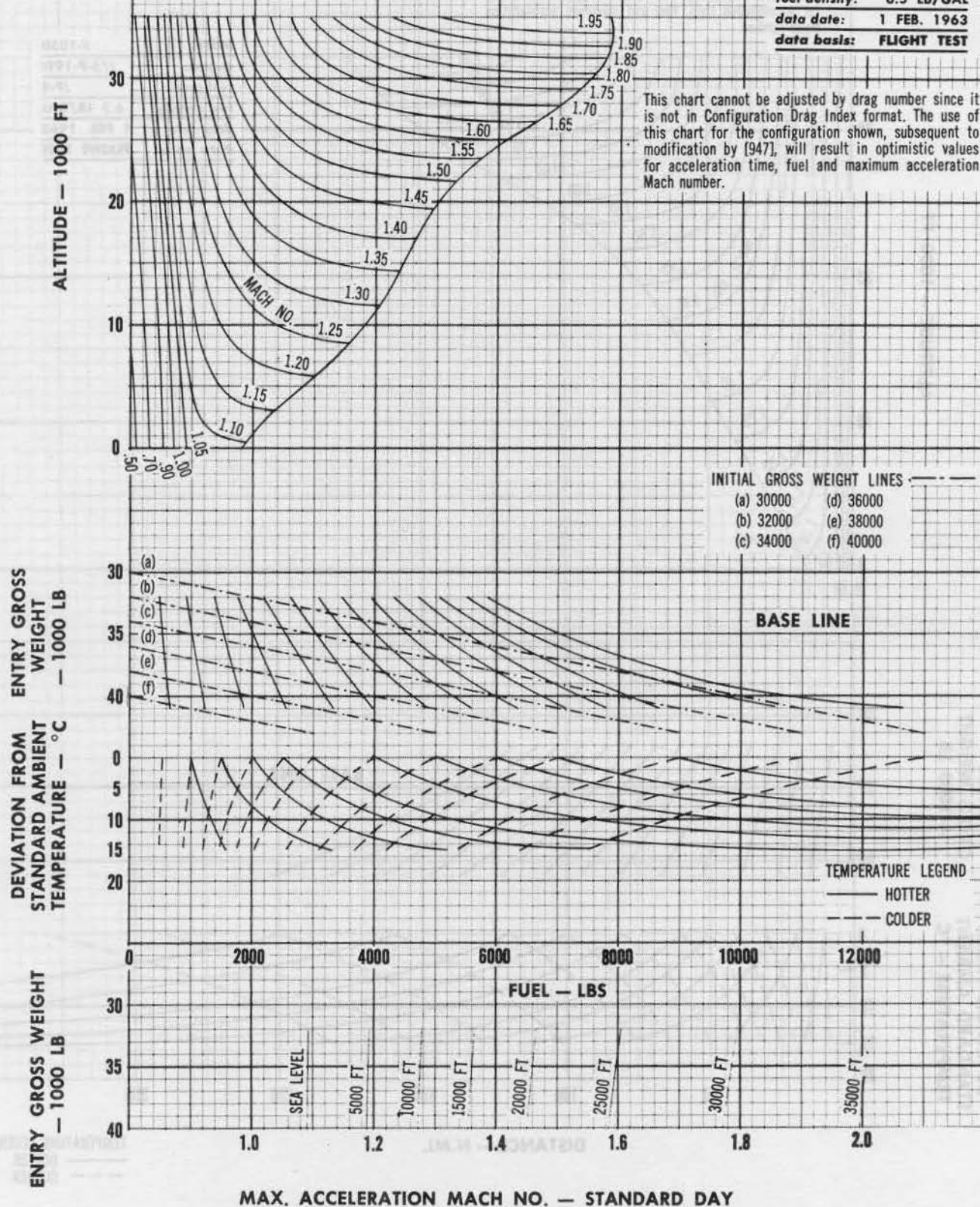


Figure A5A-4 (Sheet 1 of 3)

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

D

MAXIMUM THRUST ACCELERATION CLEAN + (2) PYLONS AND ADAPTERS FOR SIDEWINDERS (NO MISSILES)

Model:	F-105D
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 FEB. 1963
data basis:	FLIGHT TEST

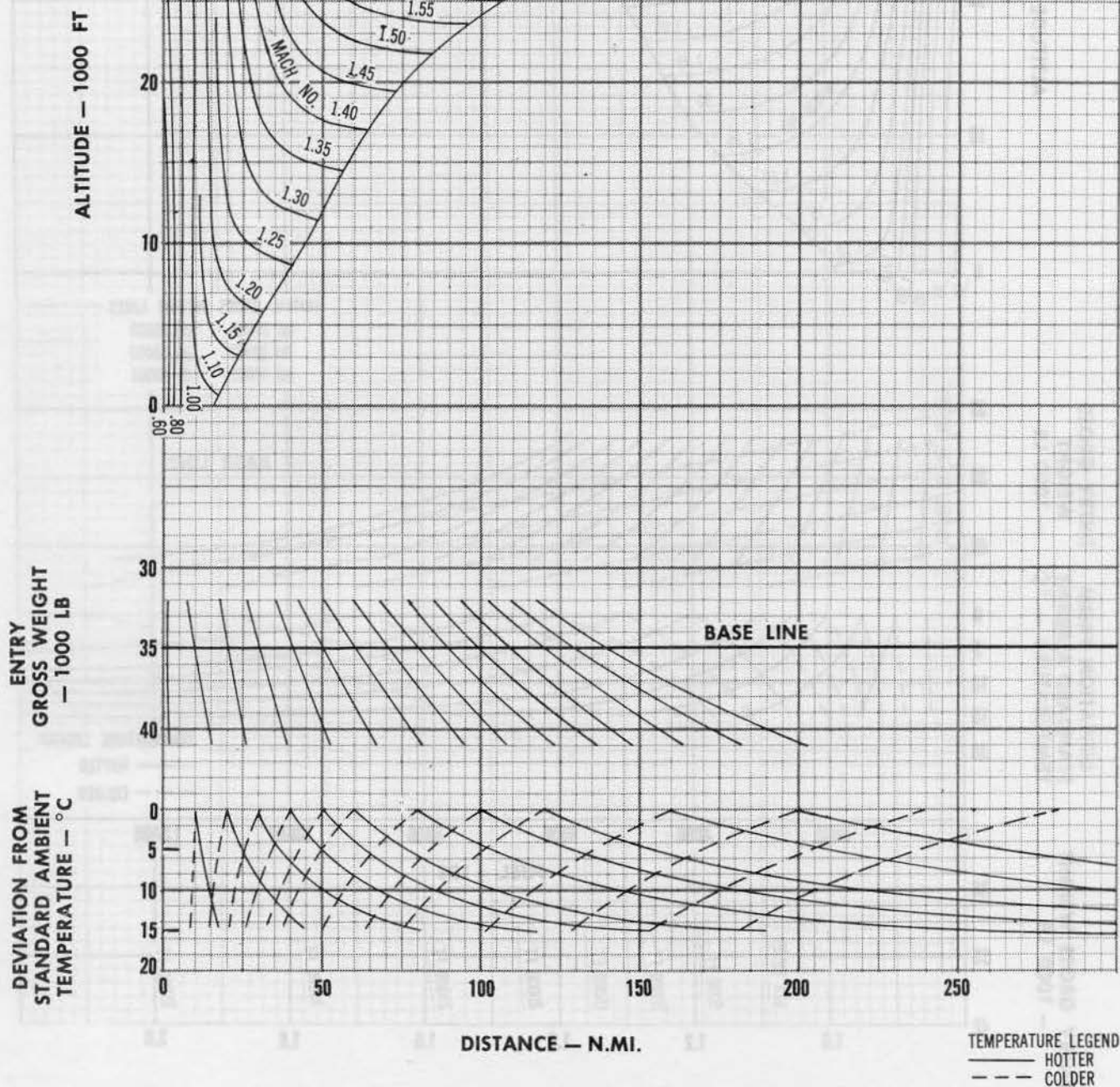


Figure A5A-4 (Sheet 2 of 3)

**MAXIMUM THRUST ACCELERATION
CLEAN + (2) PYLONS AND ADAPTERS
FOR SIDEWINDERS (NO MISSILES)**

D

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

Model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB. 1963
data basis: FLIGHT TEST

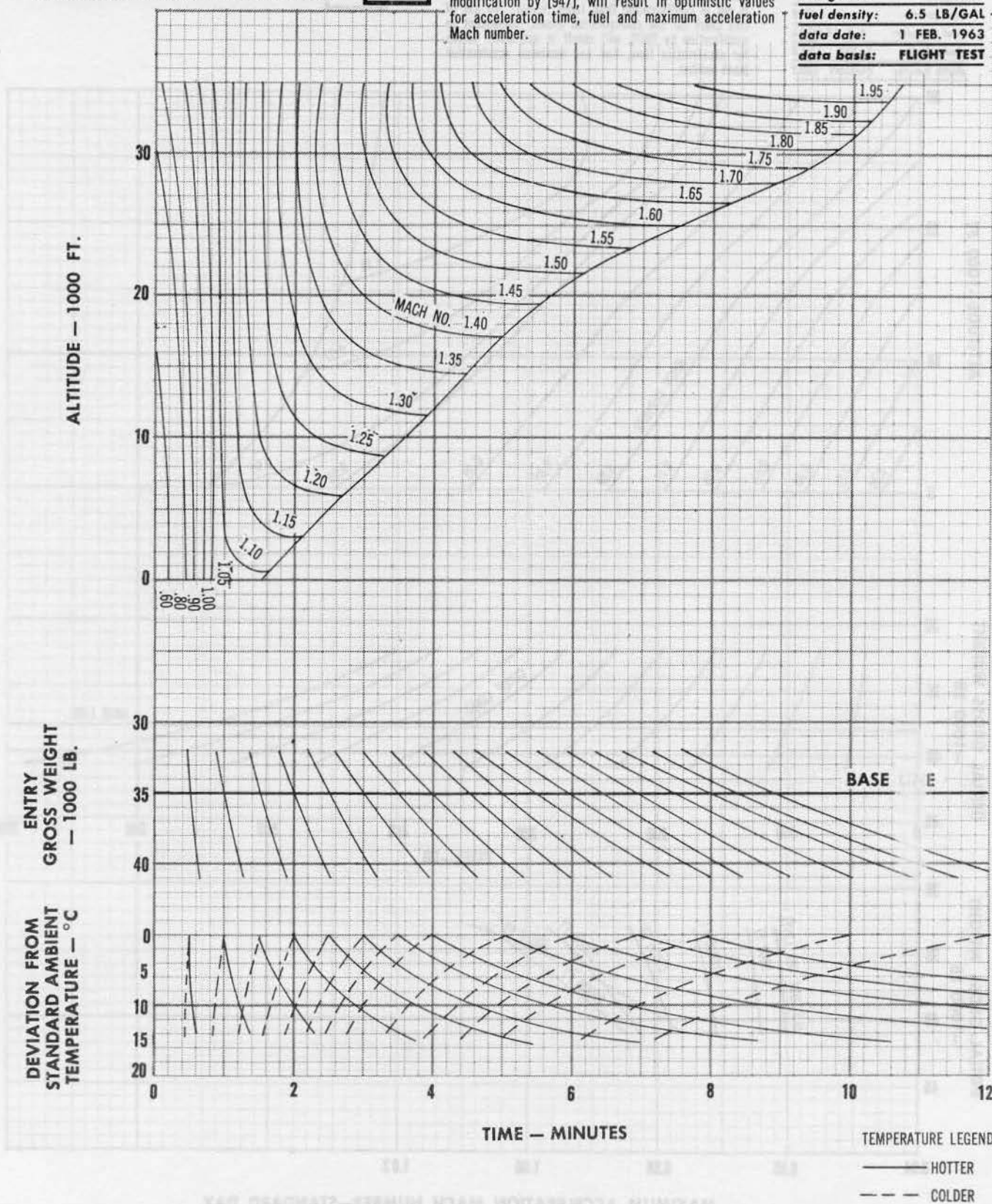


Figure A5A-4 (Sheet 3 of 3)

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.



MILITARY THRUST ACCELERATION

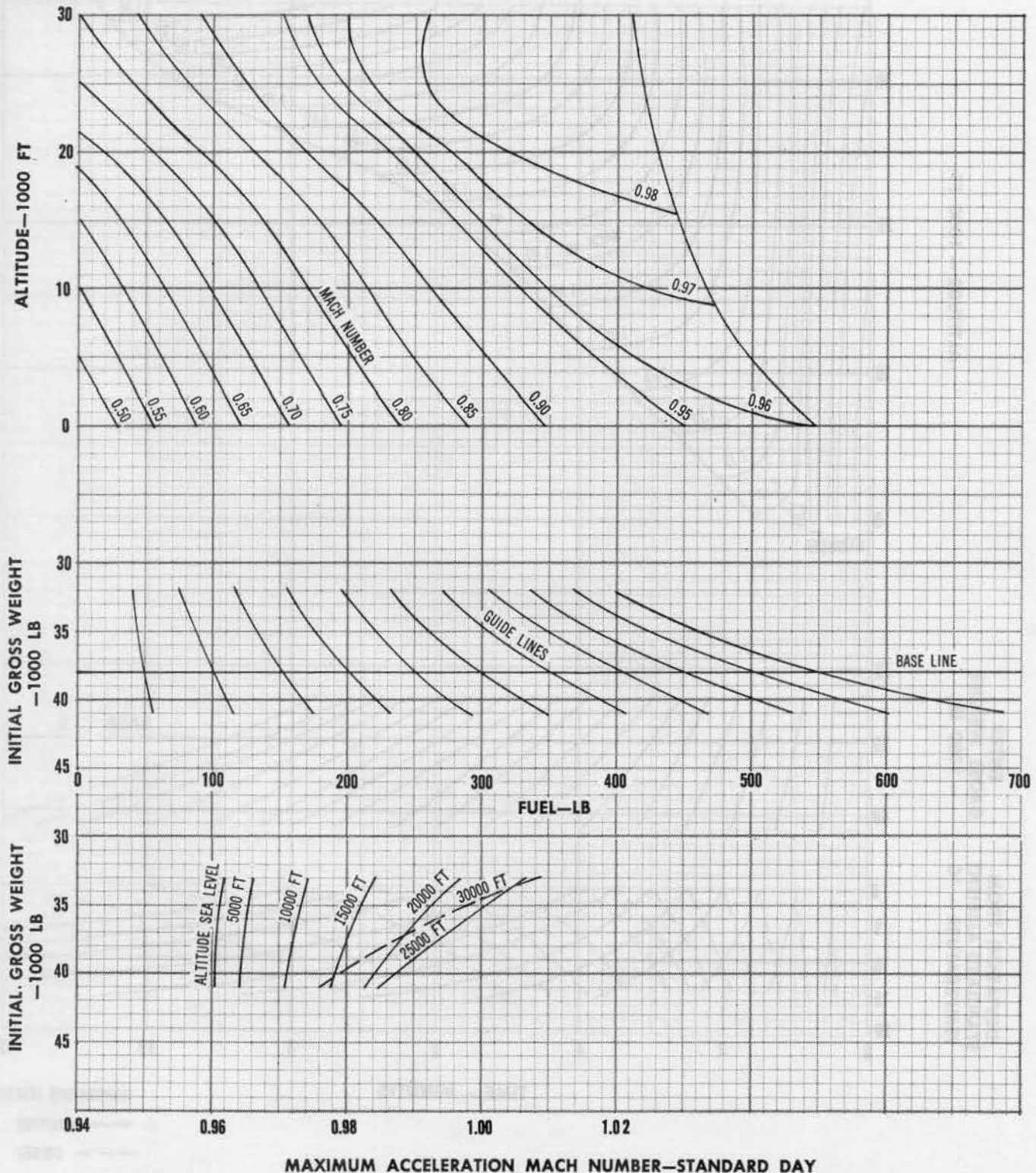
 FUEL
 CLEAN


Figure A5A-5 (Sheet 1 of 3)

**MILITARY THRUST ACCELERATION
DISTANCE
CLEAN**



Model:	F-105D
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 FEB. 1963
data basis:	FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

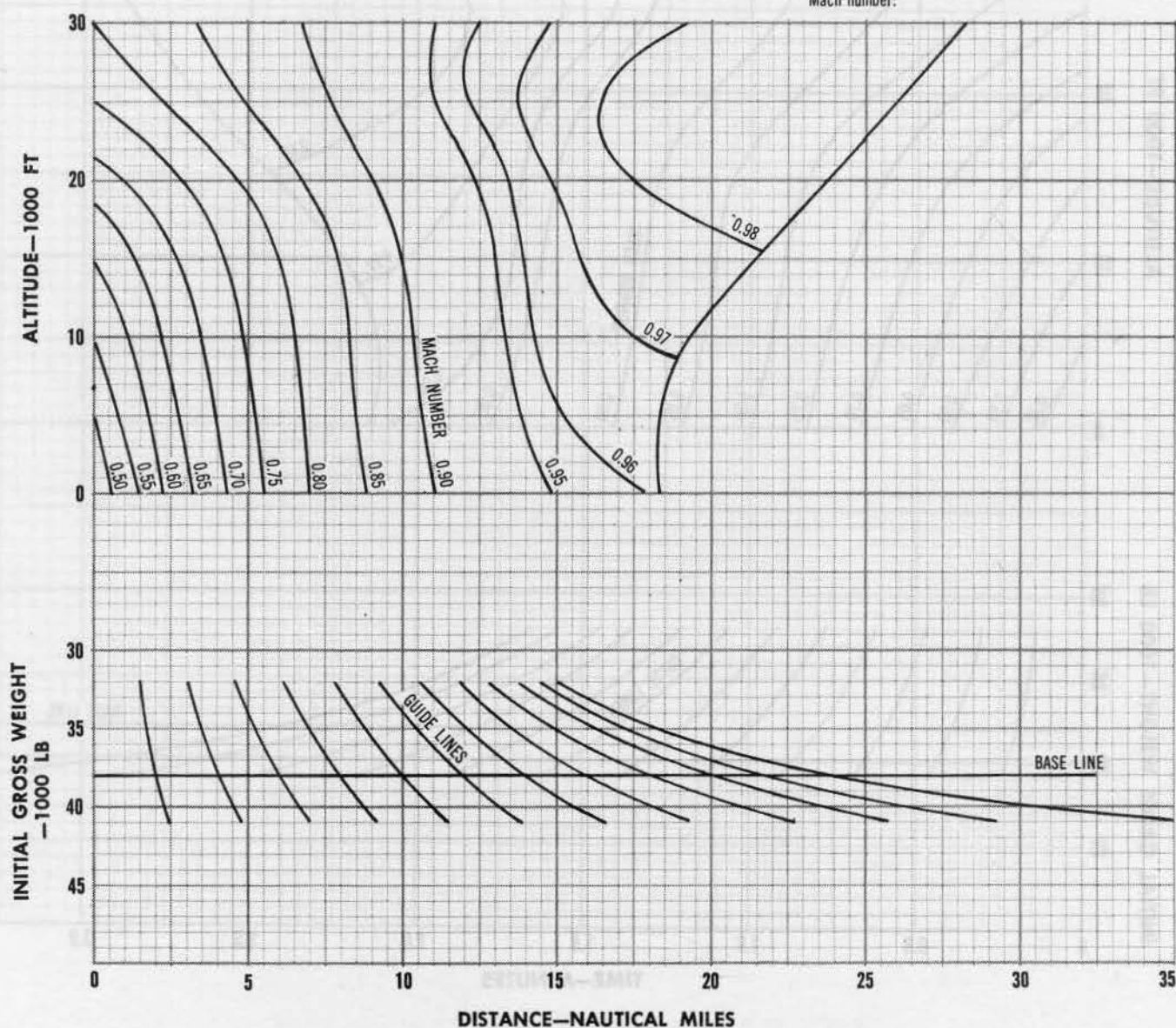


Figure A5A-5 (Sheet 2 of 3)

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST



MILITARY THRUST ACCELERATION
 TIME
 CLEAN

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

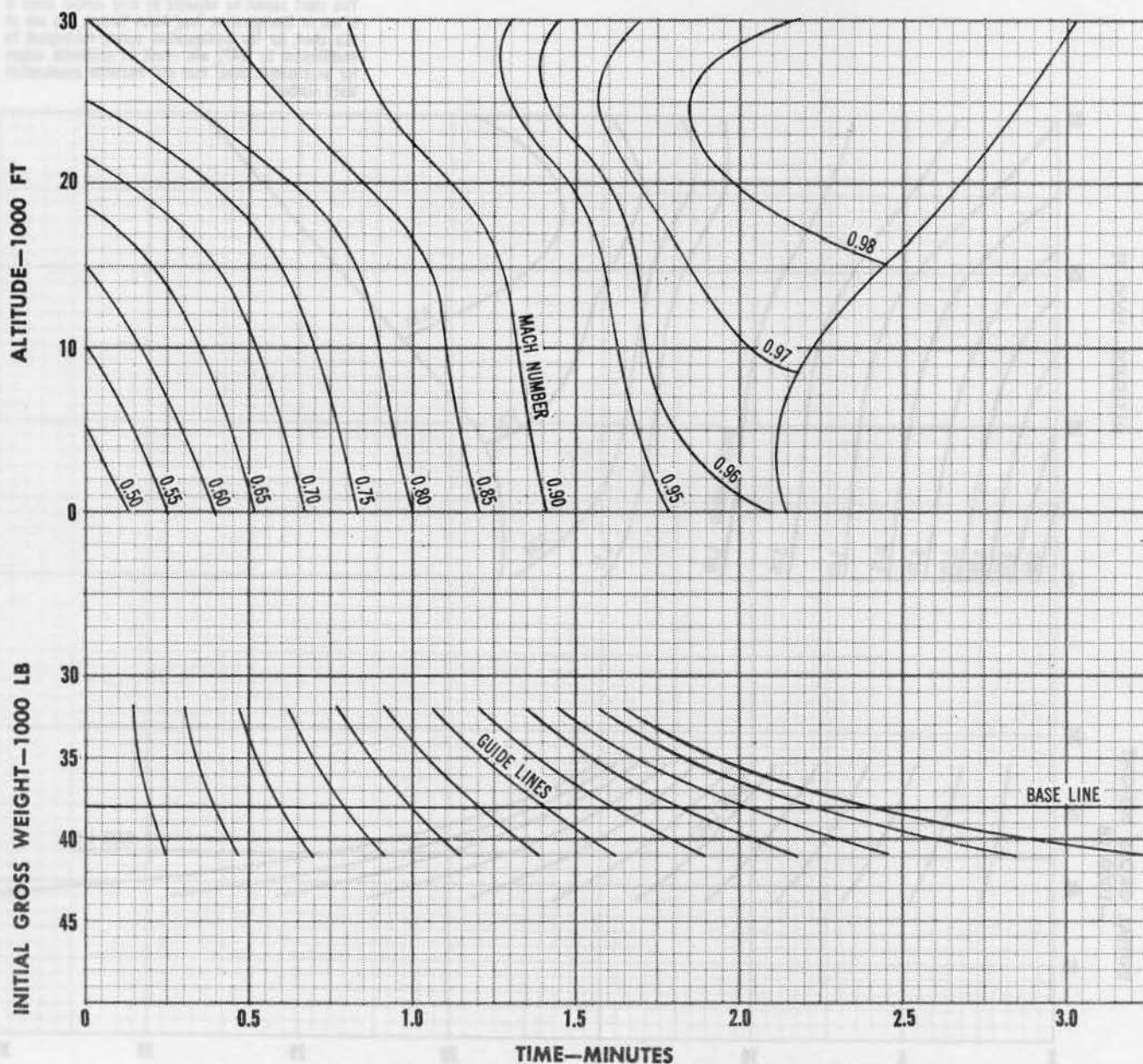


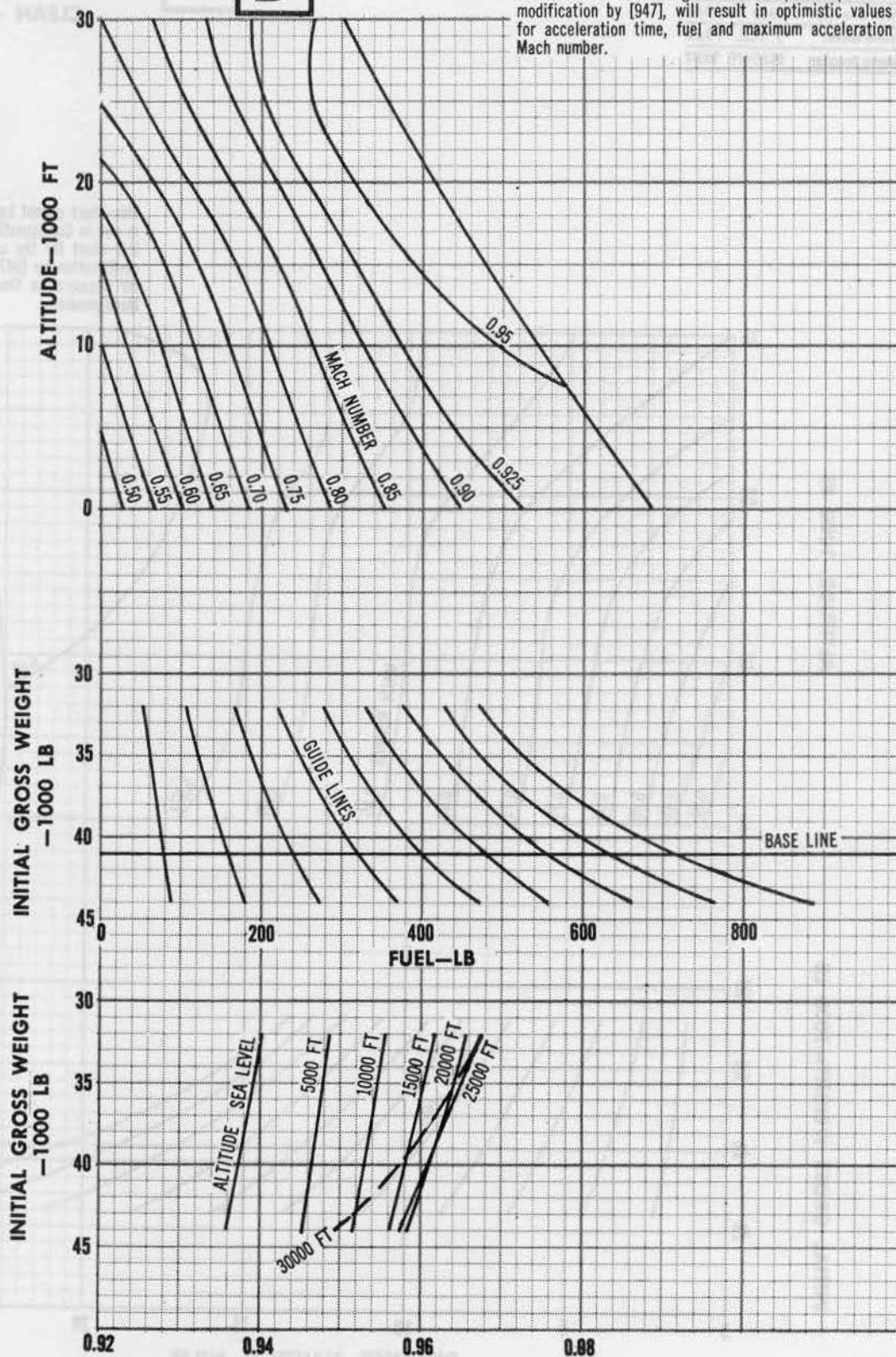
Figure A5A-5 (Sheet 3 of 3)

MILITARY THRUST ACCELERATION — FUEL CLEAN + (2) 450 GAL TANKS

D

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST



MAXIMUM ACCELERATION MACH NUMBER—STANDARD DAY

Figure A5A-6 (Sheet 1 of 3)

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST



MILITARY THRUST ACCELERATION
DISTANCE
CLEAN + (2) 450 GAL TANKS

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

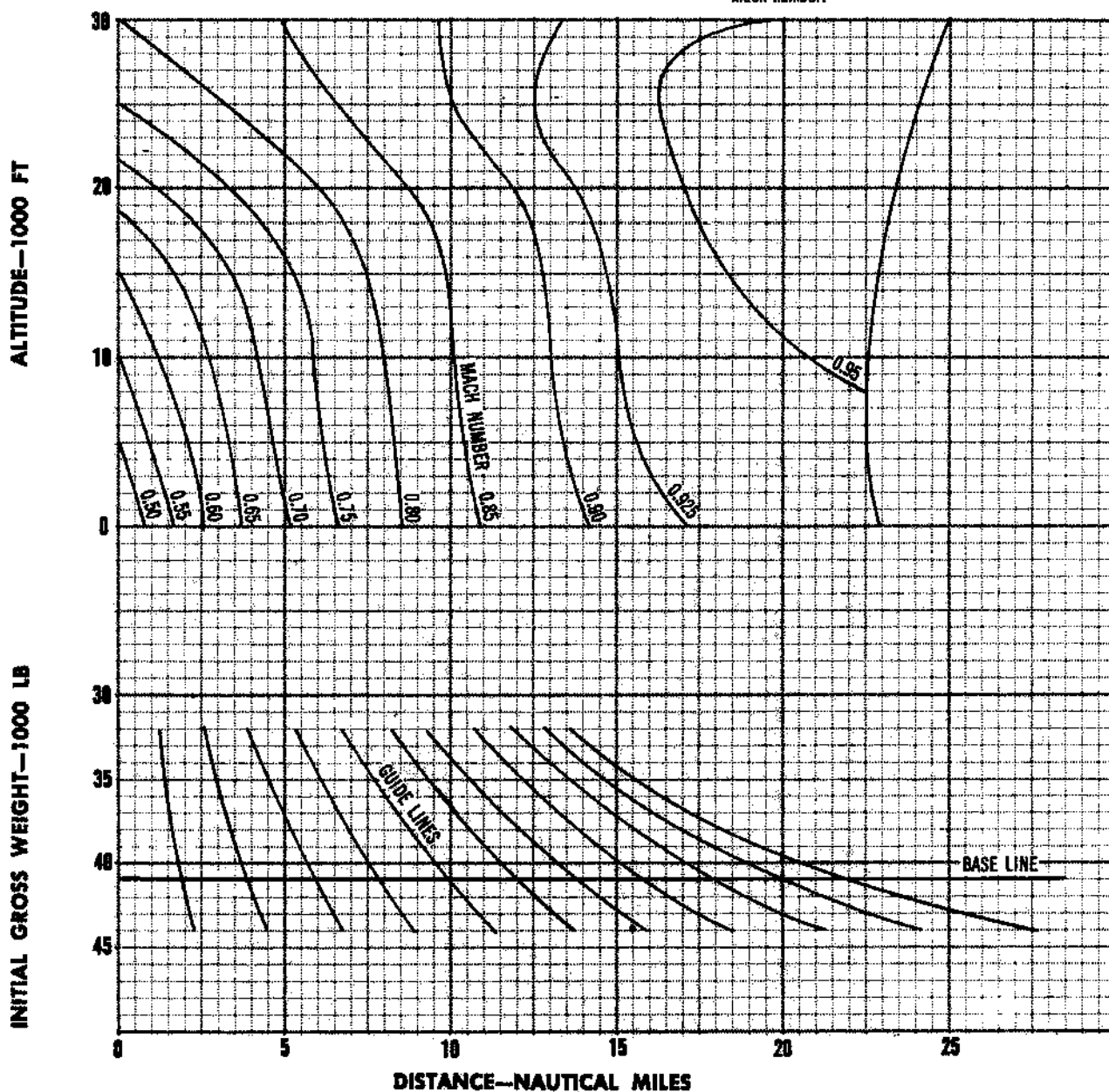


Figure A5A-6 (Sheet 2 of 3)

MILITARY THRUST ACCELERATION

TII IE

CLEAN + (2) 450 GAL TANKS



Model:	F-105D
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 FEB. 1963
data basis:	FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

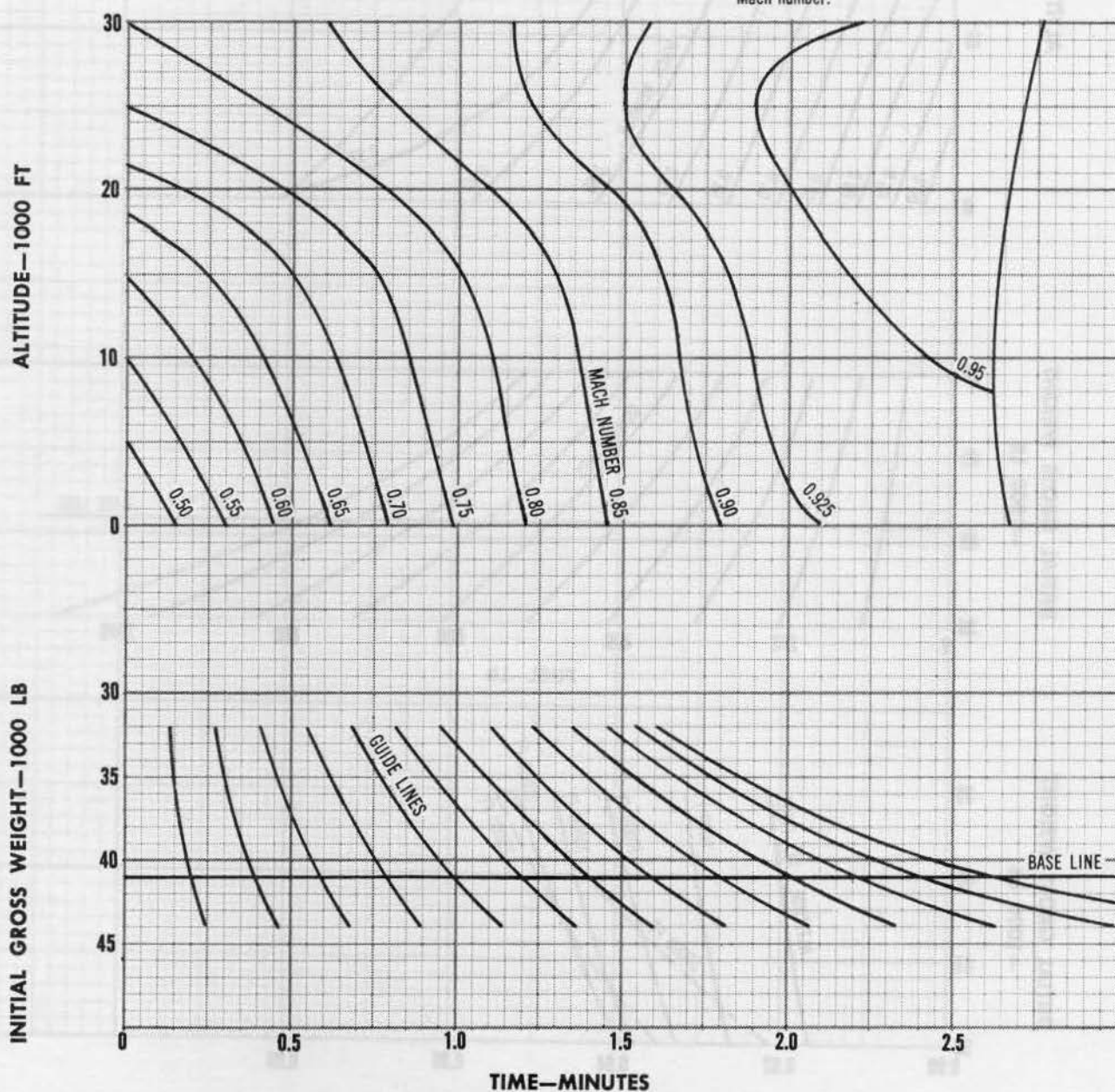
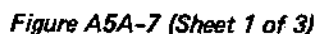


Figure A5A-6 (Sheet 3 of 3)

D

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.



**MILITARY THRUST ACCELERATION
DISTANCE**
CLEAN + CENTERLINE 650 GAL
TANK + (2) 450 GAL TANKS



Model:	F-105D
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 FEB. 1963
data basis:	FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

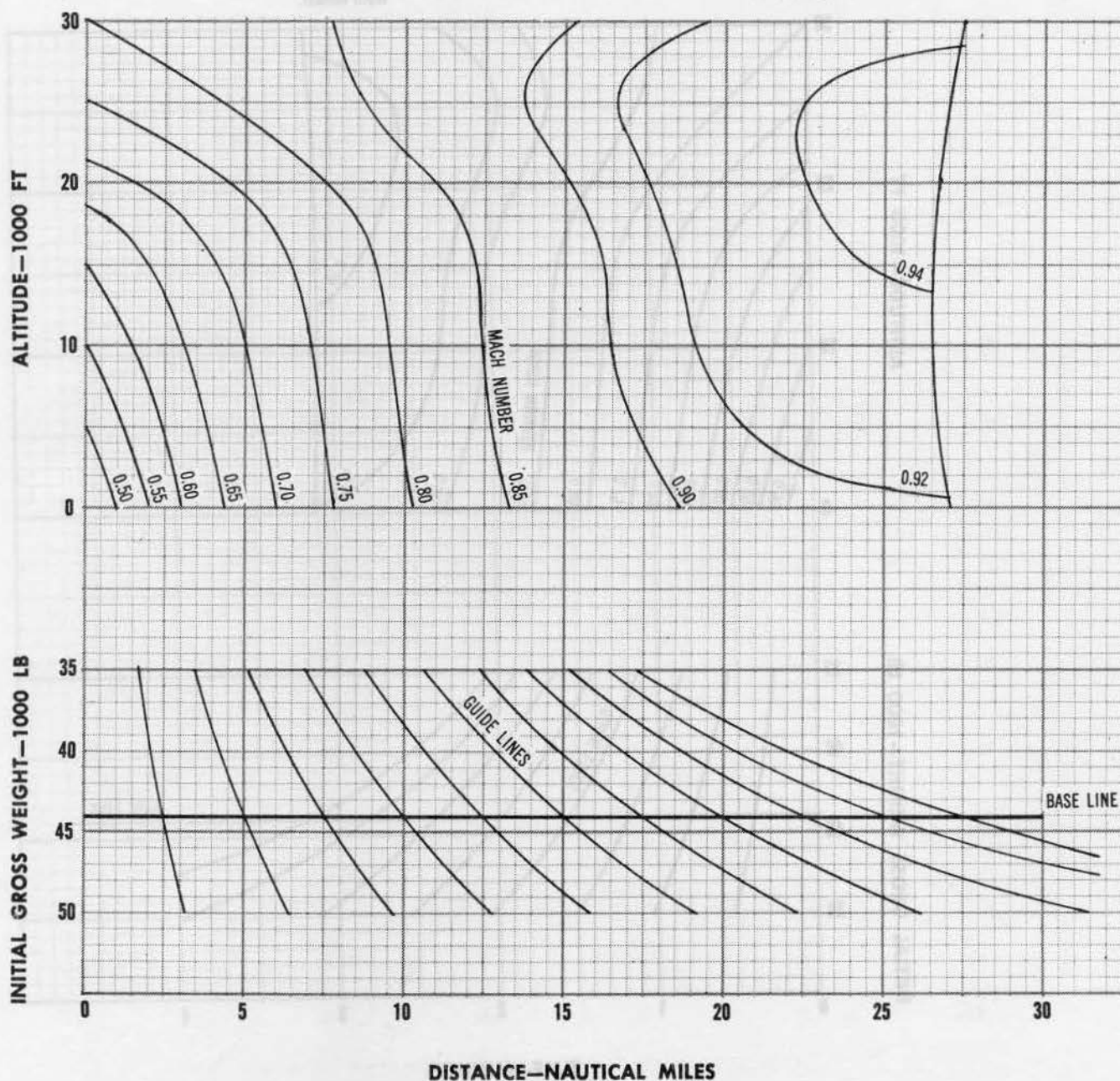


Figure A5A-7 (Sheet 2 of 3)

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST



MILITARY THRUST ACCELERATION
TIME
 CLEAN + CENTERLINE 650 GAL
 TANK + (2) 450 GAL TANKS

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

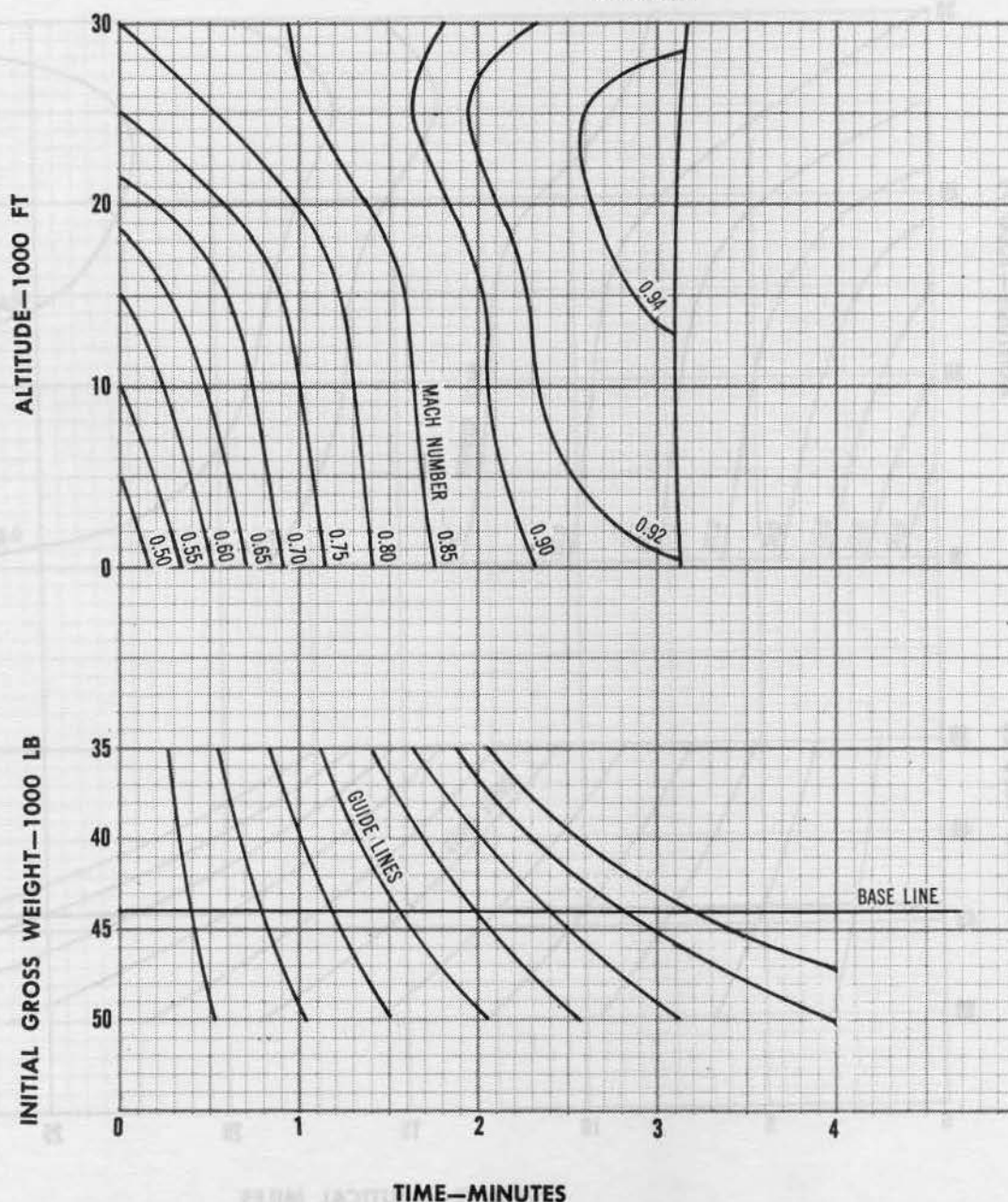


Figure A5A-7 (Sheet 3 of 3)

PART 6 AIR REFUELING

TABLE OF CONTENTS

Air Refueling Charts	A6-1, A6-2
Formating Speeds and Altitudes	A6-6
Receiver Fuel Consumption	A6-7
Fuel Transfer Time	A6-9

AIR REFUELING CHARTS: KC-135A/F-105D

Refueling data is provided in three charts: maximum formating speeds and altitudes, receiver fuel consumption, and transfer time during air refueling. The maximum formating chart is based on the receiver operating at Military Thrust at maximum gross weight (full-up condition) and the tanker at Maximum-Continuous Thrust. This chart can be read for any receiver weight and configuration, for any tanker weight, and for ambient temperatures from standard day conditions to 15°C hotter than standard.

The fuel flow of the receiver while in the refueling position is available from the fuel consumption chart for any combination of refueling altitude, speed, receiver weight and configuration, tanker weight and ambient temperature.

The transfer time chart provides data on maximum transfer rates and the relation between net transfer rates, transfer time and total fuel transferred.

EXAMPLE:

Determine formating altitude and speed, receiver fuel flow and transfer time to refuel the F-105 aircraft from the KC-135A under the following conditions:

Receiver Configuration: Clean + (2) 450 gal tanks + (4) M-117 750 lb bombs, centerline

Receiver Gross Weight: Prior to refueling: 40,000 lb

Receiver Gross Weight: After refueling 47,000 lb

Tanker Gross Weight: 200,000 lb

Formating Speed and Altitude

1. Ambient Temperature: Standard Day

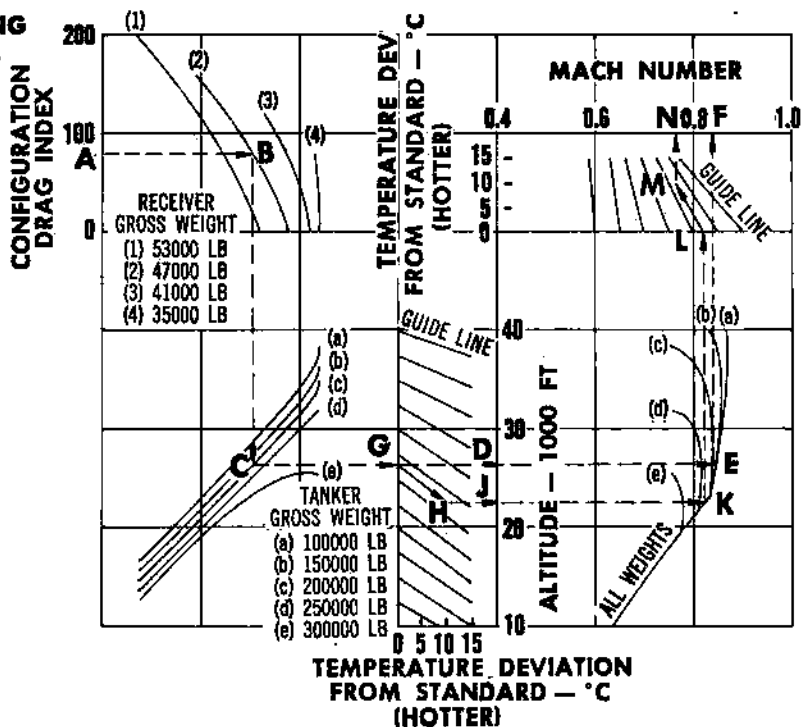
a. Determine Configuration Drag Index by adding the Store Drag Numbers from figure A1-5:

F-105D/KC-135A INFLIGHT REFUELING FORMATING SPEEDS AND ALTITUDES

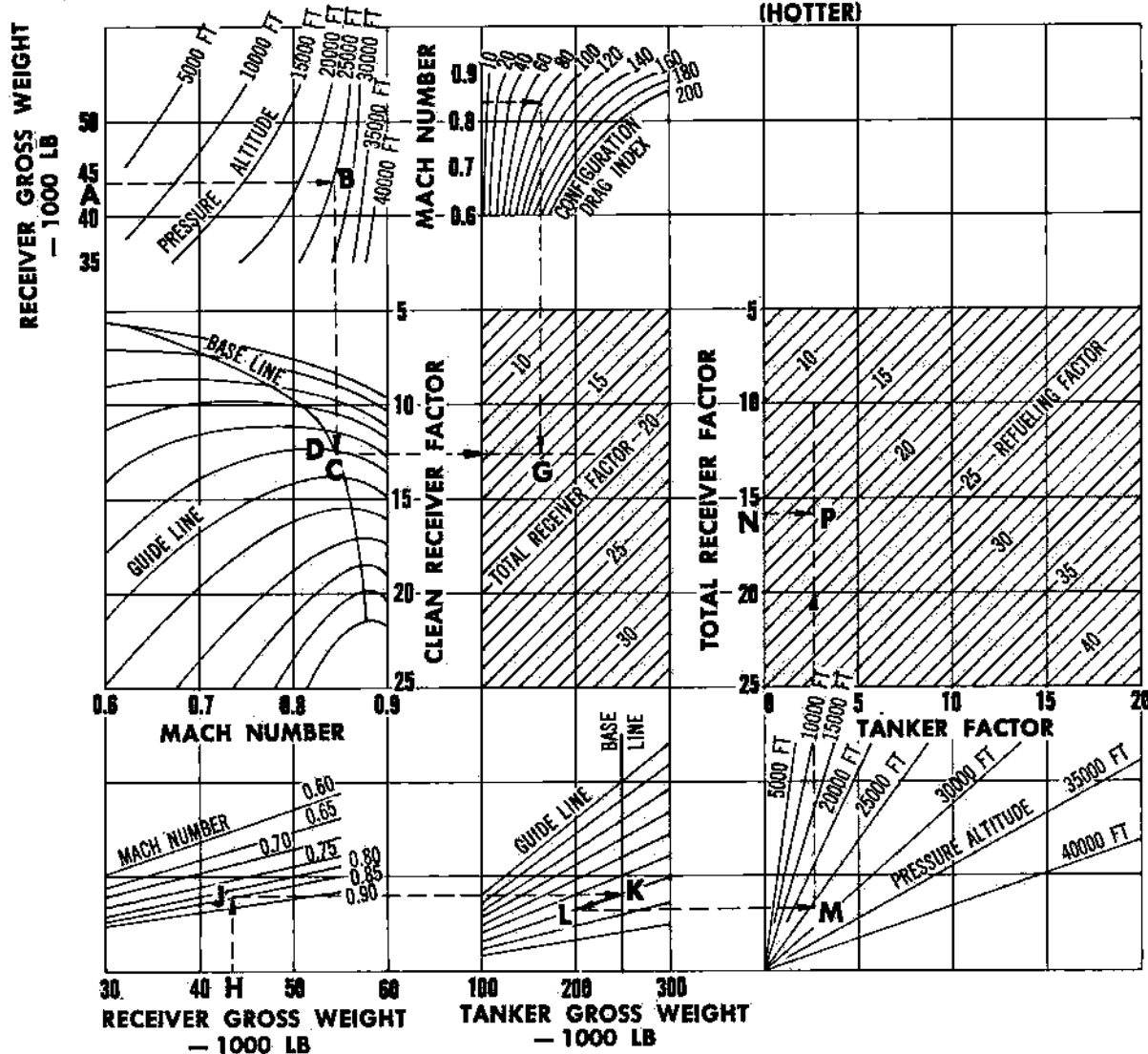
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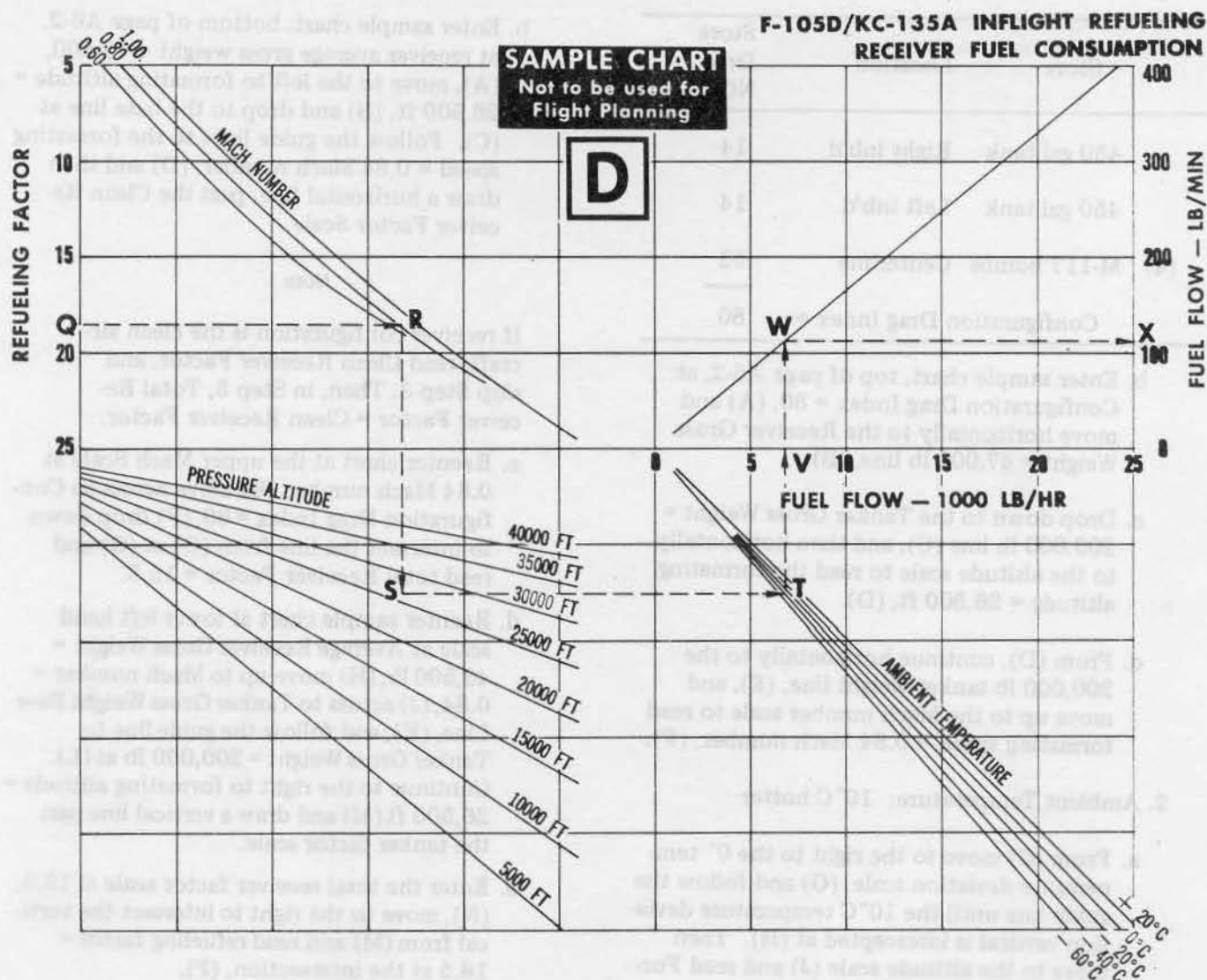
SAMPLE CHART

Not to be used for
Flight Planning



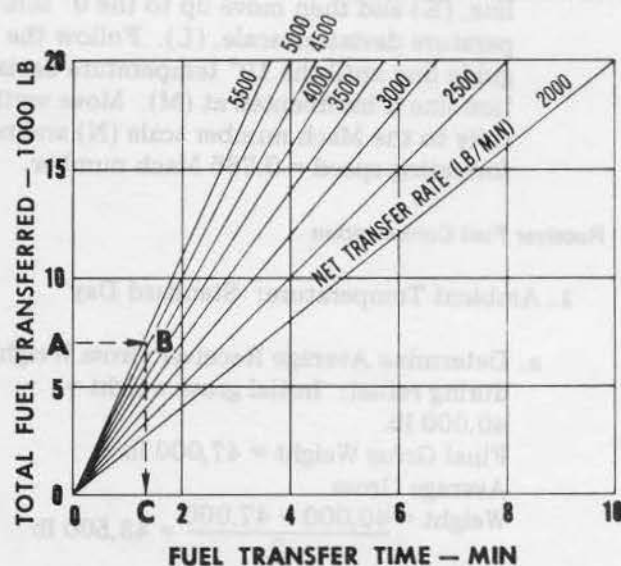
RECEIVER FUEL CONSUMPTION



**MAXIMUM FUEL TRANSFER RATES**

RECEIVER FUEL CONFIGURATION	TRANSFER RATE: LB/MIN*	
	NO BOMB BAY TANK	WITH BOMB BAY TANK
NO EXTERNAL FUEL TANK	3380	4160
CENTERLINE FUSELAGE TANK ONLY	4290	5135
TWO WING — PYLON TANKS ONLY	4615	5330
TWO WING — PYLON TANKS PLUS FUSELAGE TANK	4940	5525

*ASSUMING CONSTANT 55 PSI AT NOZZLE.

ESTIMATED NET TRANSFER RATE = MAXIMUM FUEL TRANSFER RATE (ABOVE)
— RECEIVER FUEL FLOW (LB/MIN)**FUEL TRANSFER TIME**

Store	Location	Store Drag NO.
450 gal tank	Right inb'd	14
450 gal tank	Left inb'd	14
(4) M-117 bombs	Centerline	52
Configuration Drag Index =		80

- b. Enter sample chart, top of page A6-2, at Configuration Drag Index = 80, (A) and move horizontally to the Receiver Gross Weight = 47,000 lb line, (B).
- c. Drop down to the Tanker Gross Weight = 200,000 lb line (C), and then horizontally to the altitude scale to read the forming altitude = 26,500 ft, (D).
- d. From (D), continue horizontally to the 200,000 lb tanker weight line, (E), and move up to the Mach number scale to read forming speed = 0.84 Mach number, (F).

2. Ambient Temperature: 10°C hotter

- a. From (C) move to the right to the 0° temperature deviation scale, (G) and follow the guide line until the 10°C temperature deviation vertical is intercepted at (H). Then move to the altitude scale (J) and read Forming altitude = 22,600 ft.
- b. Continue horizontally to the tanker weight line, (K) and then move up to the 0° temperature deviation scale, (L). Follow the guide line until the 10° temperature deviation line is intercepted at (M). Move vertically to the Mach number scale (N) and read forming speed = 0.765 Mach number.

Receiver Fuel Consumption

1. Ambient Temperature: Standard Day

- a. Determine Average Receiver Gross Weight during refuel: Initial gross weight = 40,000 lb.
Final Gross Weight = 47,000 lb
Average Gross Weight = $\frac{40,000 + 47,000}{2} = 43,500$ lb

- b. Enter sample chart, bottom of page A6-2, at receiver average gross weight = 43,500, (A), move to the left to forming altitude = 26,500 ft, (B) and drop to the base line at (C). Follow the guide lines to the forming speed = 0.84 Mach number, (D) and then draw a horizontal line, past the Clean Receiver Factor Scale.

Note

If receiver configuration is the clean aircraft, read Clean Receiver Factor, and skip Step 3. Then, in Step 5, Total Receiver Factor = Clean Receiver Factor.

- c. Reenter chart at the upper Mach Scale at 0.84 Mach number, (E), move across to Configuration Drag Index = 80, (F) drop down to intersect the line from (D) at (G) and read total Receiver Factor = 15.8.
 - d. Reenter sample chart at lower left hand scale at Average Receiver Gross Weight = 43,500 lb, (H) move up to Mach number = 0.84, (J) across to Tanker Gross Weight Base Line, (K), and follow the guide line to Tanker Gross Weight = 200,000 lb at (L). Continue to the right to forming altitude = 26,500 ft (M) and draw a vertical line past the tanker factor scale.
 - e. Enter the total receiver factor scale at 15.8, (N), move to the right to intersect the vertical from (M) and read refueling factor = 18.5 at the intersection, (P).
 - f. Enter sample chart, top of page A6-3, at refueling factor = 18.5, (Q), move to the left to forming speed = 0.84 (R), and drop down to altitude = 26,500 ft, (S).
 - g. From the Standard Atmosphere Chart, figure A1-10, the Standard Day Temperature at 26,500 ft = -37.5°C. Move right from (S) to -37.5°C, at (T), and up to the Fuel Flow Scale at (V), to read receiver fuel flow = 6750 lb/hr. Continue up to line at (W) and to the right to (X) for the conversion to lb/min, and read receiver fuel flow = 112 lb/min.
- ### 2. Ambient Temperature: 10°C hotter than Standard
- The same procedure as in step 1a is followed, using the forming altitude and speed developed in Forming Speed and Altitude, step 2 for pressure altitude and Mach number.

When Standard Day Temperature is read from figure A1-10, add 10°C and then continue as in step 1.

Transfer Time

1. Enter table on sample chart, bottom of page A6-3, for Receiver fuel configuration with two wing-pylon tanks, with Bomb Bay Tank, and read maximum fuel transfer rate = 5330 lb/min. Compute net transfer rate = 5330 - 112 (Receiver Fuel Consumption, step 1g) = 5218 lb/min.

2. Total fuel transferred = Final Receiver Weight minus Initial Receiver Weight = 7000 lb. Enter the total fuel transferred scale at 7000 lb. (A) move to the right to net transfer rate = 5218 lb/min. (B) and drop down to scale at (C) to read fuel transfer time = 1.35 min.

Note

This chart may also be used to determine total fuel transferable in a given time, by entering at the fuel transfer time, to an estimated net transfer rate and reading total fuel transferred.

model: KC-135A
 engine: J57-P-59W & -43WB
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST
 thrust: MAX CONTINUOUS

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST
 thrust: MILITARY



FORMATING SPEEDS AND ALTITUDES

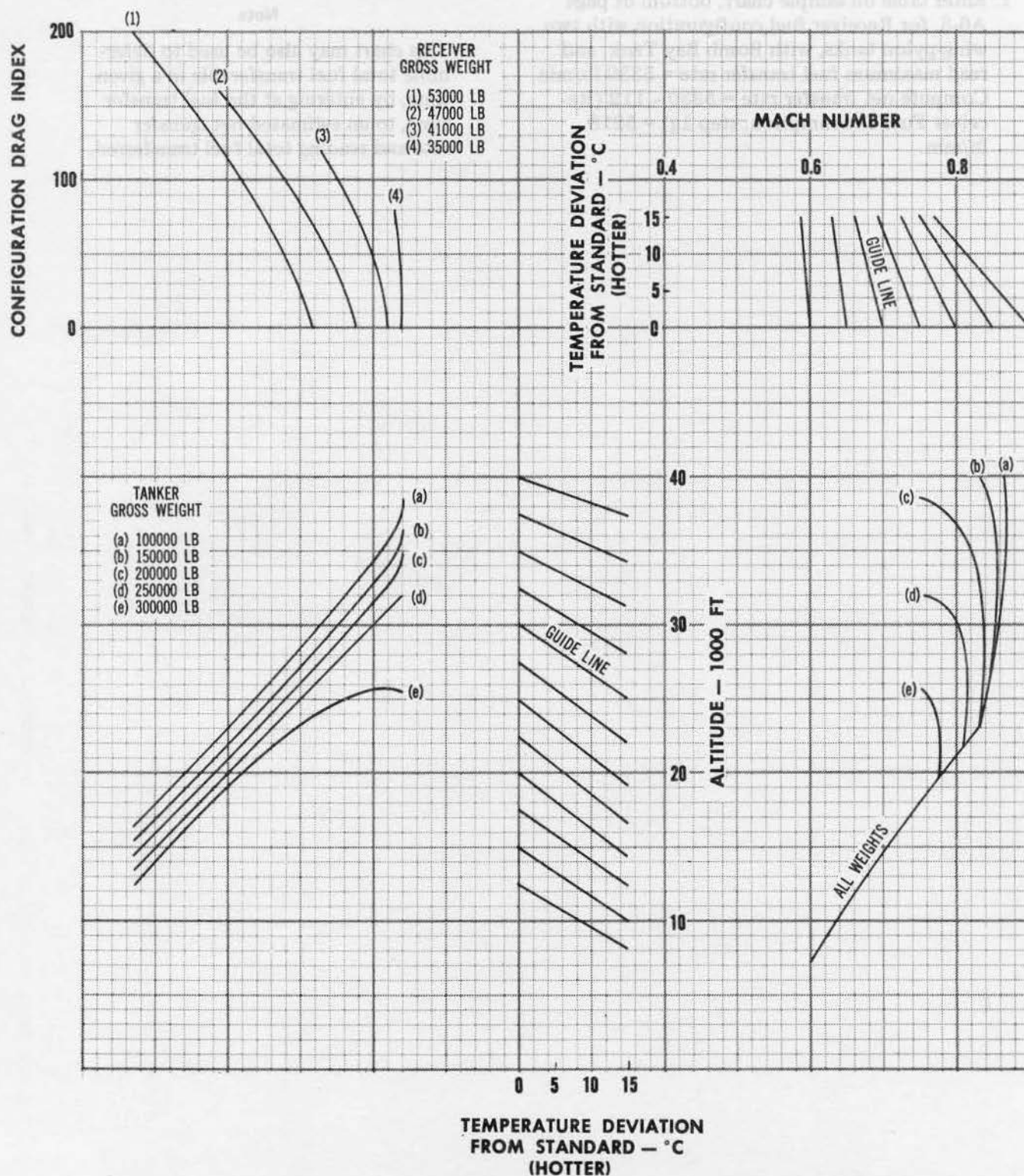


Figure A6-1

**F-105D/KC-135A INFLIGHT REFUELING
RECEIVER FUEL CONSUMPTION**


model:	F-105D
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 FEB 1963
data basis:	FLIGHT TEST

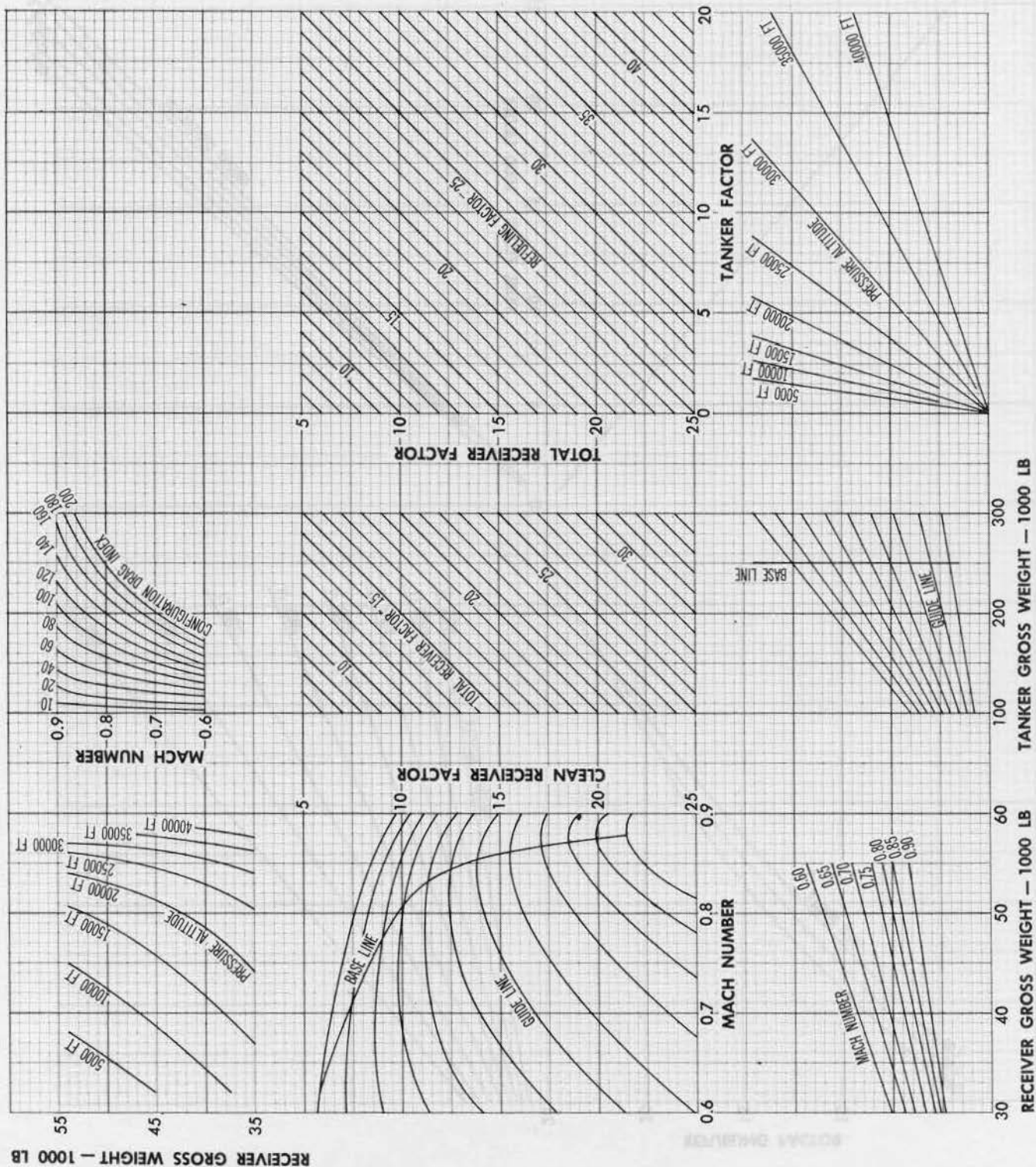


Figure A6-2 (Sheet 1 of 2)

model:	F-105D	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 FEB 1963
fuel grade:	JP-4	data basis:	FLIGHT TEST



F-105D/KC-135A INFLIGHT REFUELING RECEIVER FUEL CONSUMPTION

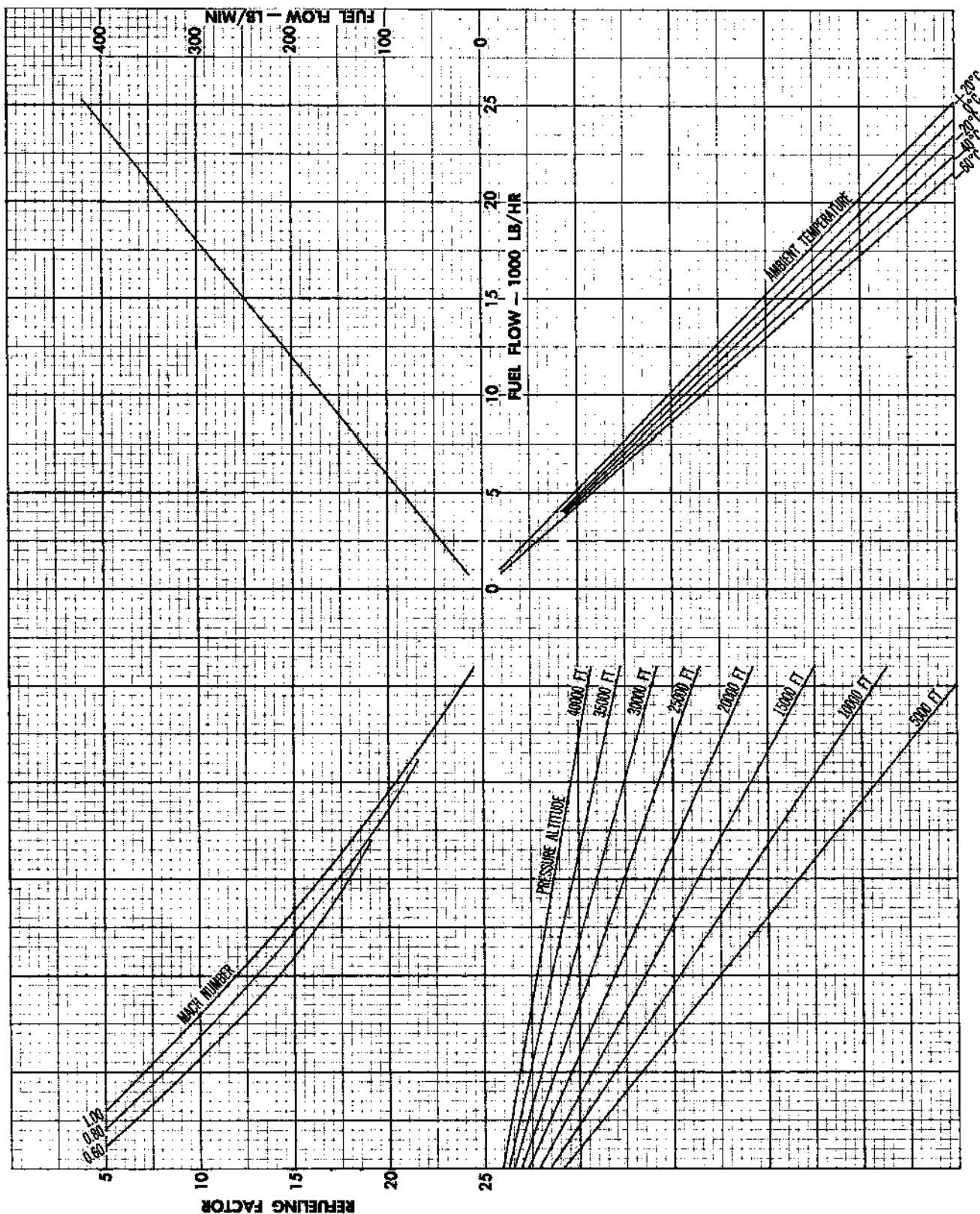


Figure A6-2 (Sheet 2 of 2)

**F-105D/KC-135A INFLIGHT REFUELING
FUEL TRANSFER TIME**


model: KC-135A
 engine: J57-P-59W & -43WB
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST
 thrust: MAX CONTINUOUS

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST
 thrust: MILITARY

MAXIMUM FUEL TRANSFER RATES

RECEIVER FUEL CONFIGURATION	TRANSFER RATE: LB/MIN*	
	NO BOMB BAY TANK	WITH BOMB BAY TANK
NO EXTERNAL FUEL TANK	3380	4160
CENTERLINE FUSELAGE TANK ONLY	4290	5135
TWO WING — PYLON TANKS ONLY	4615	5330
TWO WING — PYLON TANKS PLUS FUSELAGE TANK	4940	5525

*ASSUMING CONSTANT 55 PSI AT NOZZLE.

ESTIMATED NET TRANSFER RATE=MAXIMUM FUEL TRANSFER RATE (ABOVE) — RECEIVER FUEL FLOW (LB/MIN)

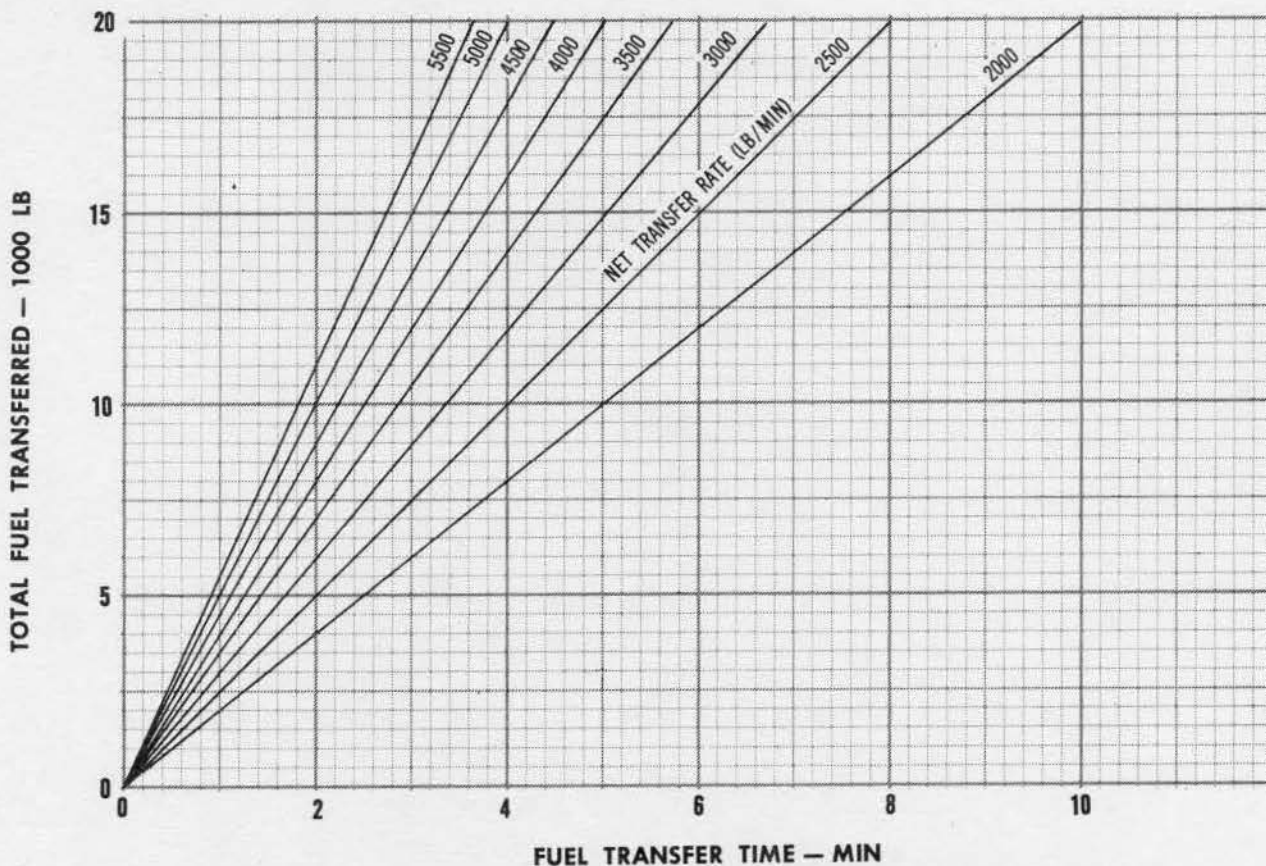


Figure A6-3

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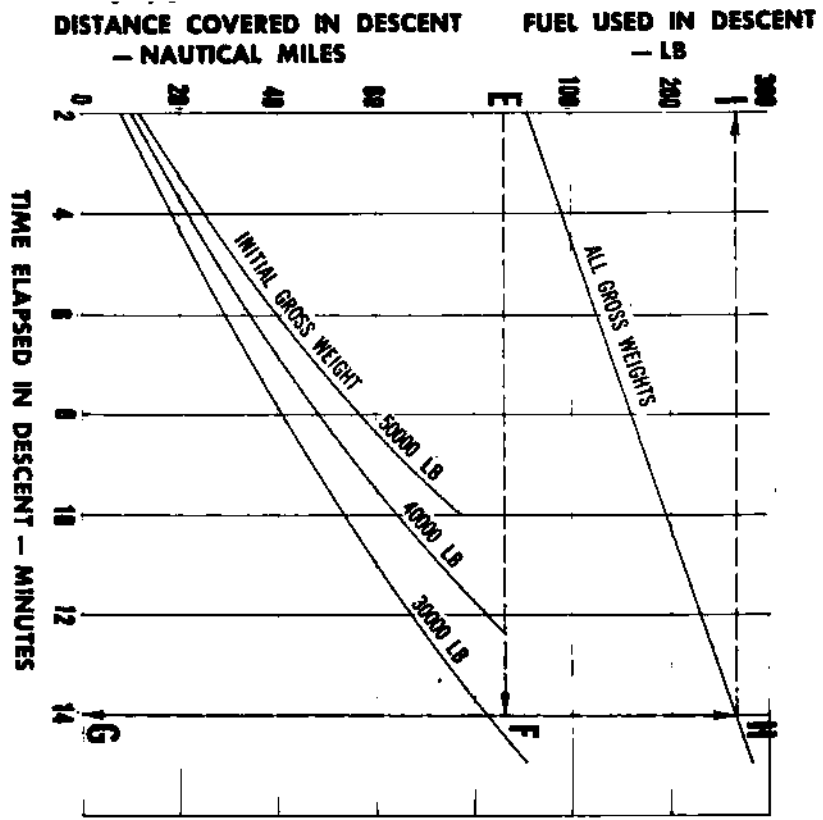
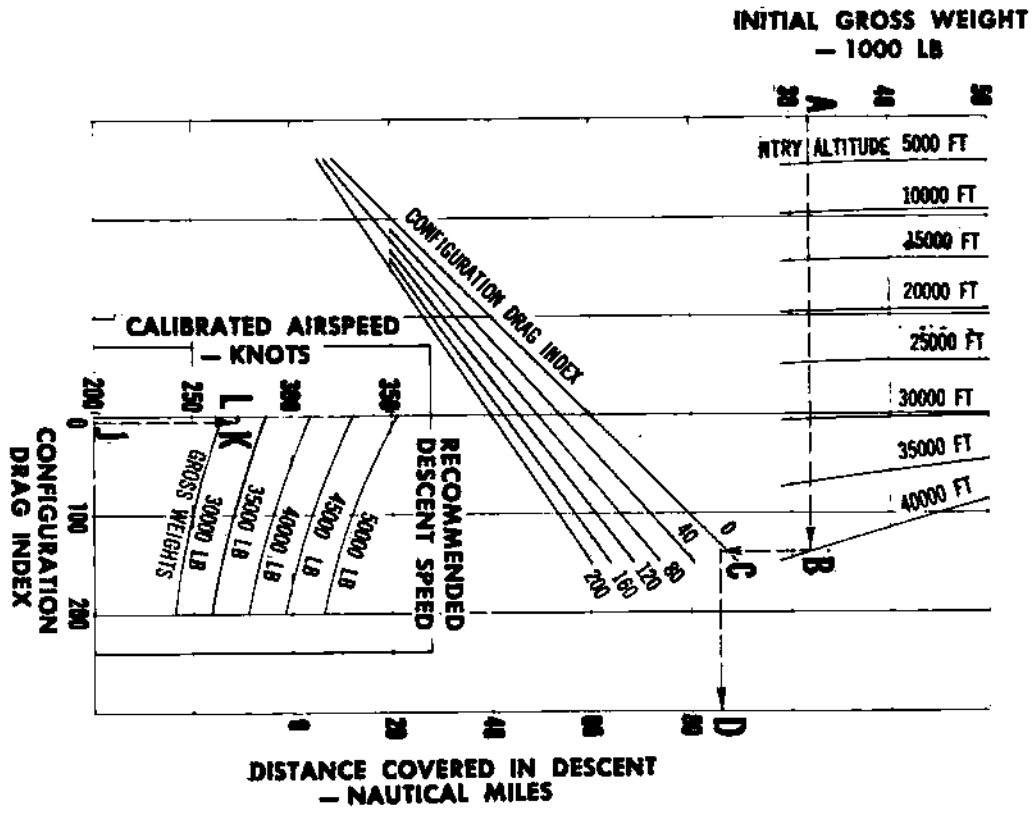
PART 7 DESCENT**TABLE OF CONTENTS**

Descent Information	A7-1
Maximum Range Descent Charts	A7-2, A7-4
Combat Descent Chart	A7-6
Penetration Descent Chart	A7-7

DESCENT INFORMATION.

The Descent Charts enable the pilot to determine the fuel used, distance covered and time elapsed in any one of three types of descent, between any two altitudes, at any conditions of aircraft weight and configuration. The descent schedules shown are:

Type	Thrust Setting	Speed	Speed Brakes
Maximum Range	Idle	Shown on Chart	In
Penetration	88%	300 KCAS	Out
Combat	Idle	0.9M or 400 KCAS whichever is less	



SAMPLE CHART
Not to be used for
Flight Planning

Model:	F-105D
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 FEB. 1963
data basis:	FLIGHT TEST



MAXIMUM RANGE DESCENT

EXAMPLE I

Conditions: Configuration: Clean + (2) Special AIM-9B Pylons

Initial Gross Weight: 32,000 lb

Entry Altitude: 40,000 ft

Final Altitude: Sea Level

Find: Fuel used, distance covered and time elapsed in a Maximum Range Descent, and the recommended speed schedule.

Solution:

1. Determine the configuration drag index from the table of figure A1-5 by adding the various store drag numbers.

Store	Location	Store Drag NO.
(1) Special AIM-9B Pylon	Left Outb'd	3
(1) Special AIM-9B Pylon	Right Outb'd	3
Configuration Drag Index =		6

2. Enter sample chart on page A7-2
At Initial Gross Weight = 32,000 lb, (A)
Move horizontally to Entry Altitude = 40,000 ft, (B)
Drop vertically to Configuration Drag Index = 6, (C)
Move to the right to the Distance Scale, (D) and read Distance covered = 86 NMI
3. Enter sample chart on page A7-2
At Distance covered in Descent = 86 NMI, (E)
Move to the right to Initial Gross Weight = 32,000 lb, (F)
Drop to the Time scale, (G) and read Time Elapsed = 14 Min
Move up from (F) to the fuel line at (H)
Move to the left to the fuel used scale, (I) and read Fuel Used = 267 lb
4. Read Recommended Descent Speed from sample chart on page A7-2 by entering the Configuration Drag Index scale at 6, (J) moving up to Gross Weight = 32,000 lb, (K) and moving to the left to the Calibrated Airspeed Scale, (L) and reading 273 KCAS.

The Penetration Descent (88% RPM and 300 KCAS) and Combat Descent (M = 0.9 or 400 KCAS, whichever is less) Charts are similar in appearance to the Maximum Range Descent Charts and are used in the same manner.

MAXIMUM RANGE DESCENT

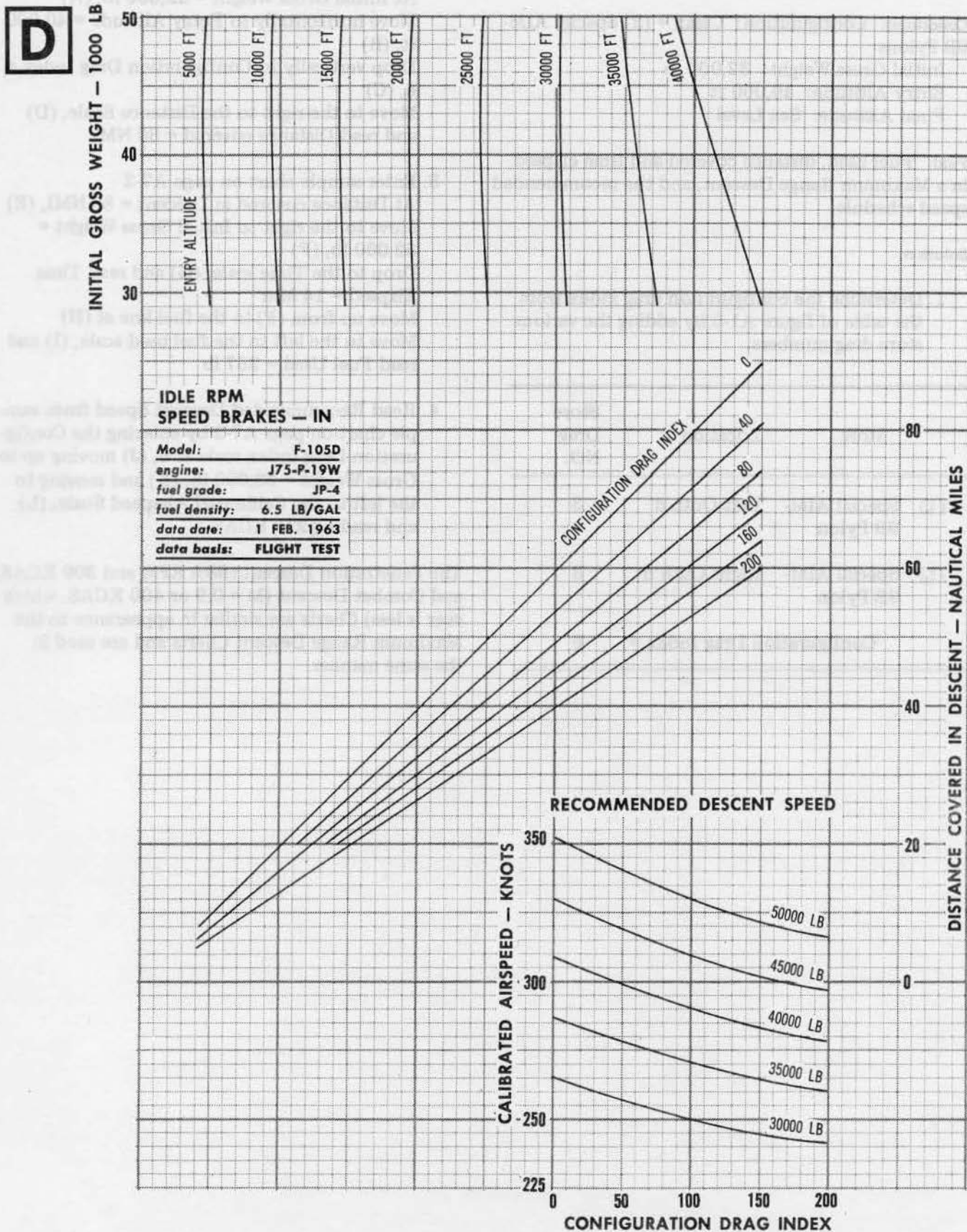


Figure A7-1 (Sheet 1 of 2)

IDLE RPM
SPEED BRAKES — IN



MAXIMUM RANGE DESCENT

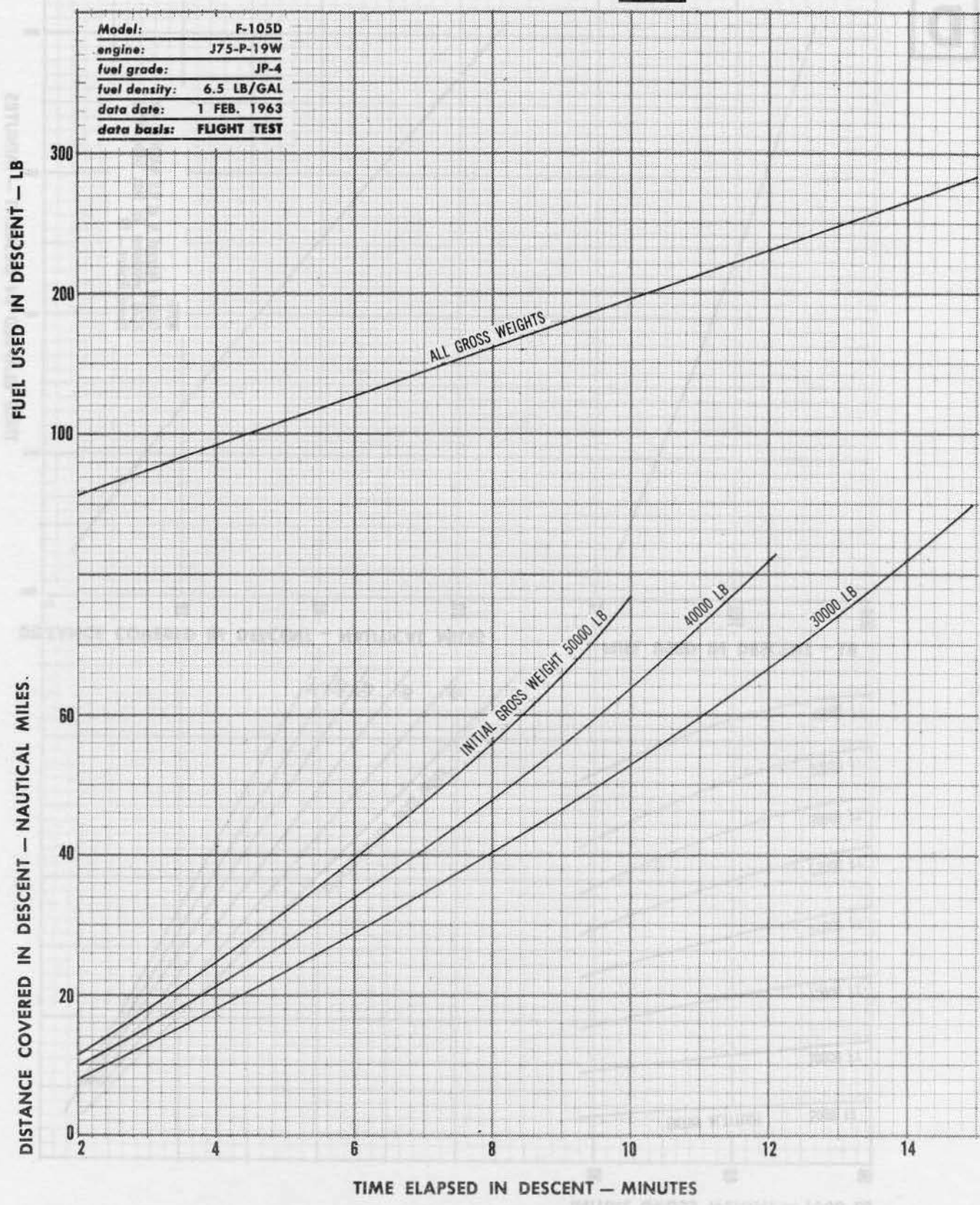


Figure A7-1 (Sheet 2 of 2)

COMBAT DESCENT

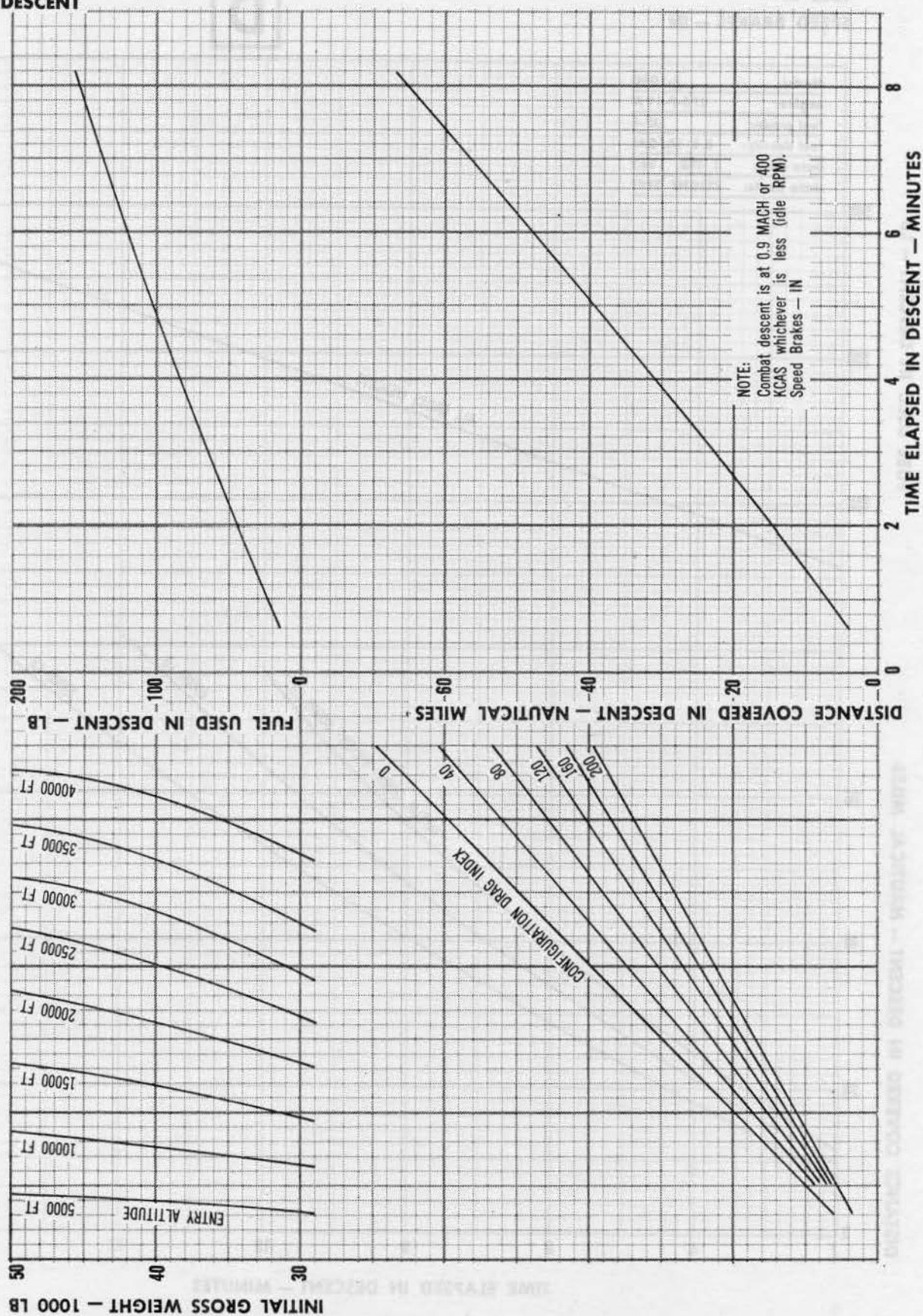
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Figure A7-2

PENETRATION DESCENT

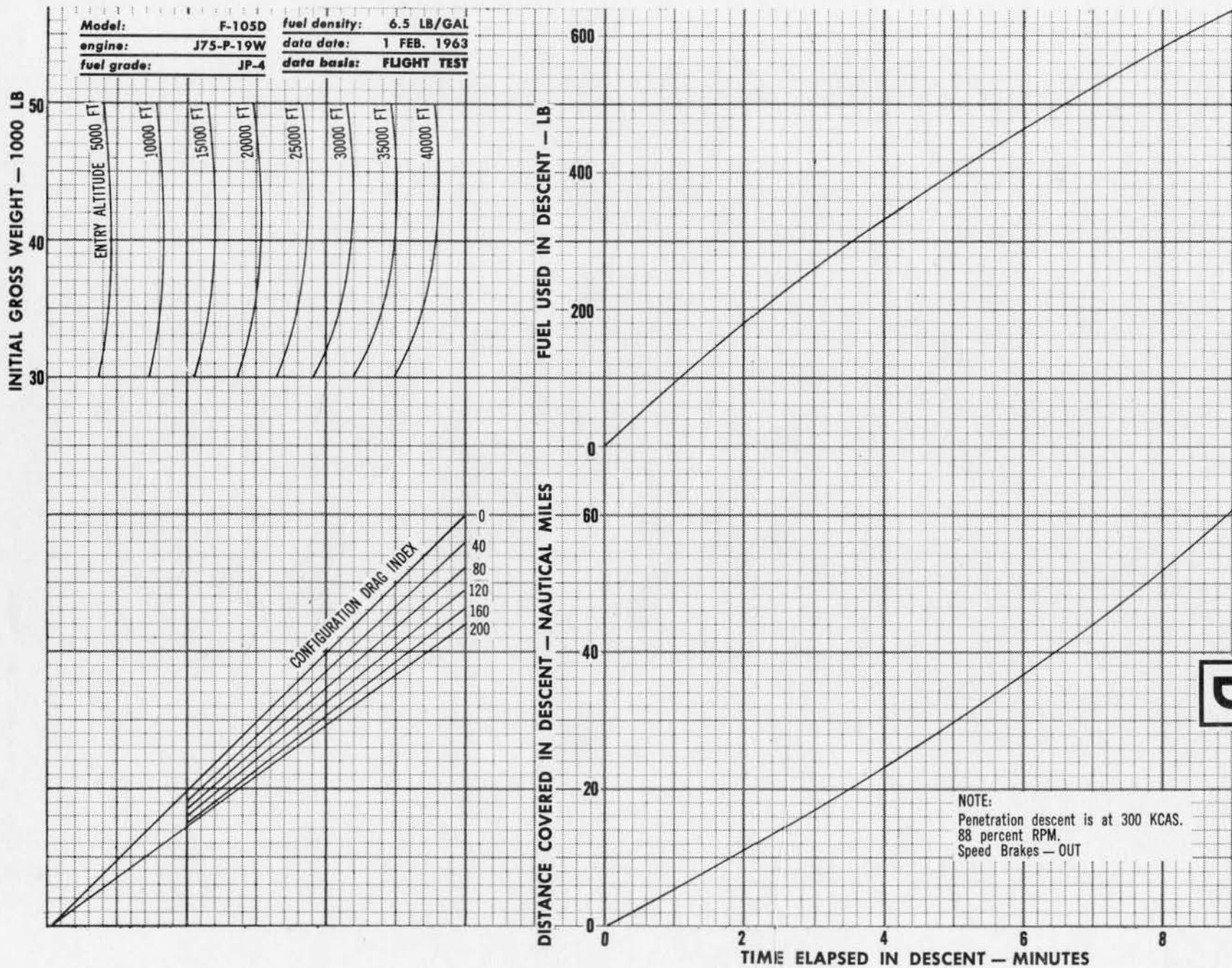
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Figure A7-3

A7-7/(A7-8 blank)

PART 8 LANDING

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Landing Distances	A8-1, A8-5, A8-7
Runway Conditions	A8-1
Crosswind Landing Chart	A8-1, A8-9

LANDING DISTANCE

Separate landing ground roll and total distance to clear a 50 foot obstacle charts are shown for landings with and without drag chute deployment. These data are computed for flaps and gear down, speed brakes open. Effects on landing distances of ambient temperature, pressure altitude, aircraft gross weight, runway wind component, runway gradient and runway condition reading are shown on the ground roll charts. Incremental drag for externally loaded configurations has been accounted for at various aircraft gross weights. The effect of braking on a dry runway is shown separately, and total distance over 50 feet is read against ground roll and braking effectiveness. Landing speeds at final approach, 50 foot obstacle and touchdown are presented as a function of gross weight. The use of these charts is illustrated below by a sample problem.

RUNWAY CONDITIONS

In order that pilots might be aware of slippery conditions at terminal airfields, a system of reporting has been established. First, a teletype sequence will report conditions as a series of letters to indicate the runway surface condition. The number portion of this sequence is the Runway Condition Reading (RCR). Second, Air Traffic Control will report the information concerning Runway Surface Condition and Runway Condition Reading for the benefit of aircraft anticipating a landing. Following is an explanation of the terms used:

RCR	—	Runway Condition Reading
P	—	Patchy
WR	—	Wet Runway
SLR	—	Slush on Runway

LSR	—	Loose Snow on Runway
PSR	—	Packed Snow on Runway
IR	—	Ice on Runway

CROSSWIND LANDING CHART

The crosswind landing chart defines the conditions, in terms of wind direction and velocity and aircraft gross weight, under which it is possible to correct drift by holding the upwind wing down, through touchdown, thereby maintaining an uncrabbed approach. Increased touchdown speeds above normal, shown versus crosswind component and landing weight, are required to compensate for the loss in lift due to spoiler deflection. For very high crosswinds, indicated on the chart by the lightly shaded area, a combination of crab and upwind wing low approach is required. If the crosswind component is greater than 40 knots, the maximum sideslip angle available is not sufficient to avoid drift at touchdown, and landing under these conditions is not recommended. An example to illustrate its use is given on the crosswind chart.

Sample Problem

- Determine speeds and distances for landing with drag chute under the following conditions:
 Gross Weight: 38,000 lb
 OAT: 10°C
 Pressure Altitude: 4000 ft
 Wind Component: 10 knots (headwind)
 Runway Gradient: 2% downhill
 RCR: 15

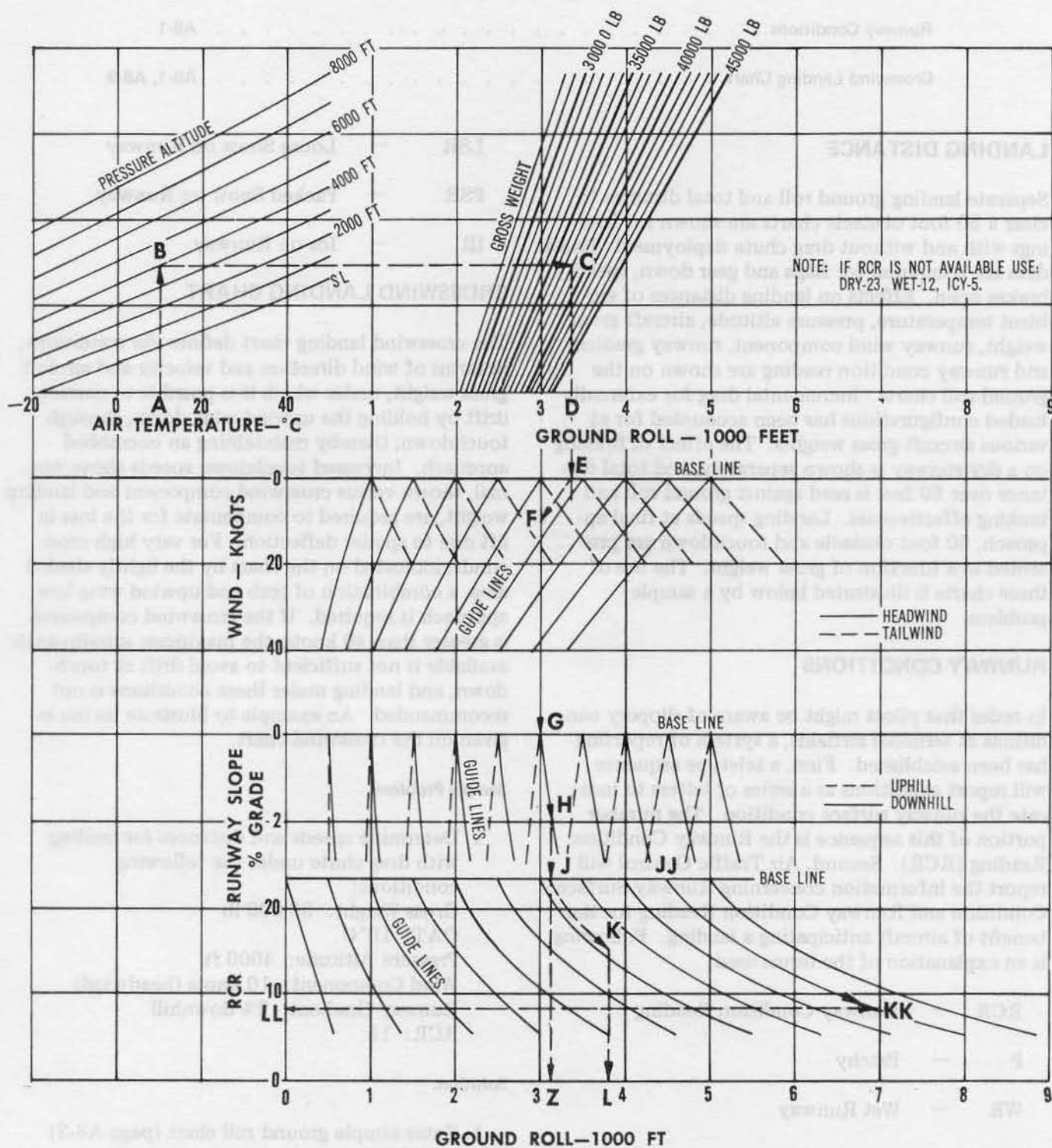
Solution:

- Enter sample ground roll chart (page A8-2) at 10°C air temperature, (A), move up to

GROUND ROLL LANDING DISTANCE WITH DRAG CHUTE

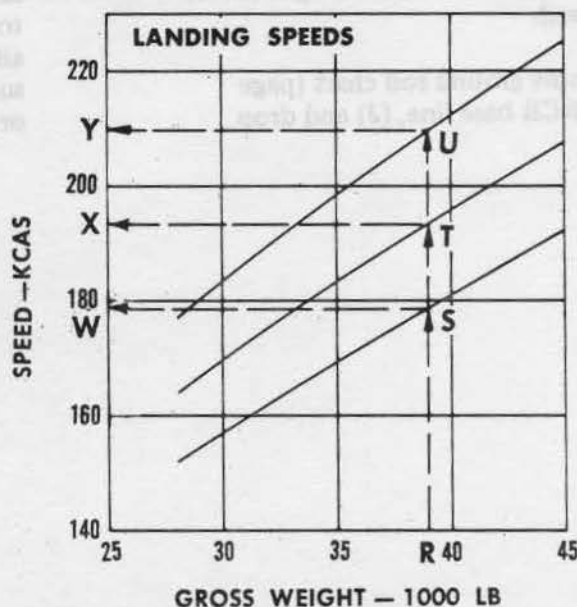
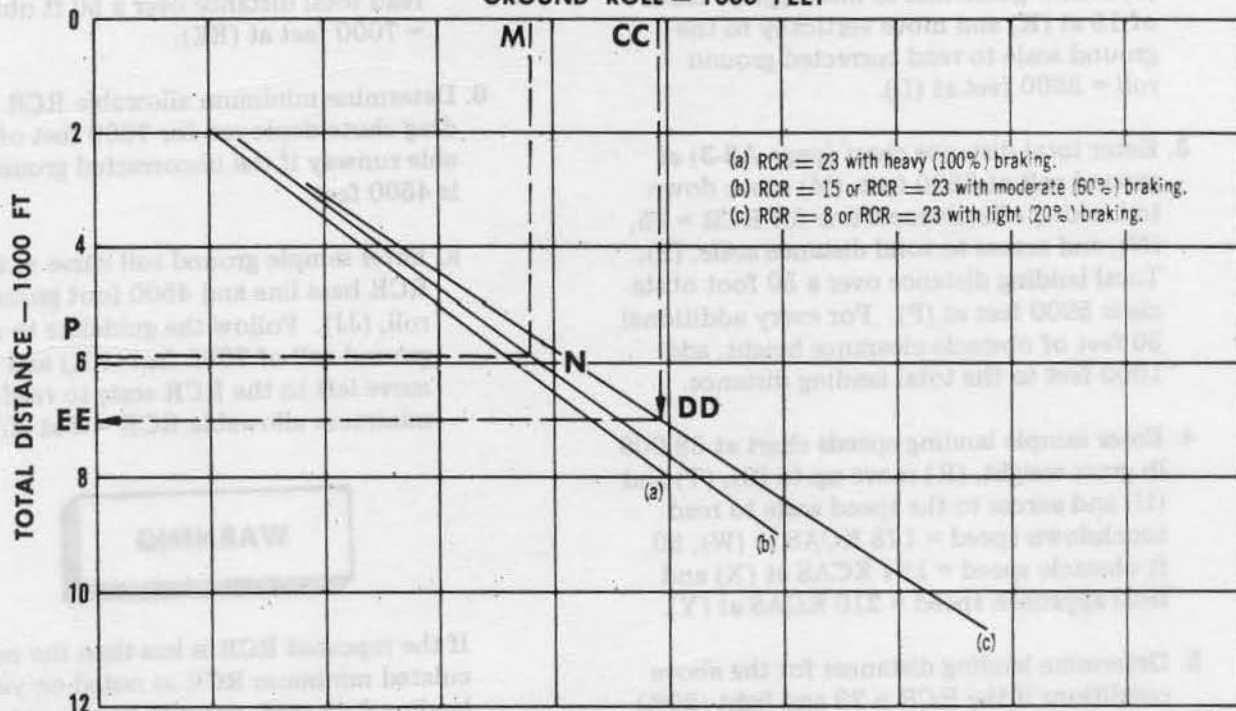
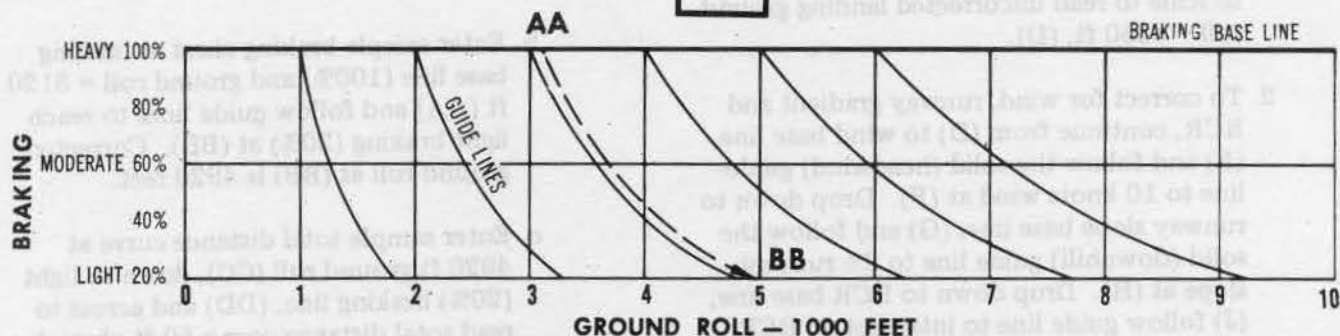


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D

**GROUND ROLL LANDING DISTANCE
WITH DRAG CHUTE**



SAMPLE CHART
Not to be used for
Flight Planning

4000 ft pressure altitude line, (B) across to 38,000 lbs gross weight line, (C) and down to scale to read uncorrected landing ground roll = 3350 ft, (D).

2. To correct for wind, runway gradient and RCR, continue from (D) to wind base line, (E) and follow the solid (headwind) guideline to 10 knots wind at (F). Drop down to runway slope base line, (G) and follow the solid (downhill) guide line to 2% runway slope at (H). Drop down to RCR base line, (J) follow guide line to intercept an RCR of 15 at (K) and move vertically to the ground scale to read corrected ground roll = 3800 feet at (L).
3. Enter total distance chart (page A8-3) at ground roll of 3800 feet, (M) move down to braking effectiveness line for RCR = 15, (N), and across to total distance scale, (P). Total landing distance over a 50 foot obstacle is 5900 feet at (P). For every additional 50 feet of obstacle clearance height, add 1000 feet to the total landing distance.
4. Enter sample landing speeds chart at 38,000 lb gross weight, (R) move up to (S), (T) and (U) and across to the speed scale to read touchdown speed = 178 KCAS at (W), 50 ft obstacle speed = 194 KCAS at (X) and final approach speed = 210 KCAS at (Y).
5. Determine landing distances for the above conditions if the RCR = 23 and light (20%) braking is used.
 - a. Enter sample ground roll chart (page A8-2) at RCR base line, (J) and drop

down to read ground roll = 3120 ft at (Z).

- b. Enter sample braking chart at braking base line (100%) and ground roll = 3120 ft (AA) and follow guide lines to reach light braking (20%) at (BB). Corrected ground roll at (BB) is 4920 feet.
- c. Enter sample total distance curve at 4920 ft ground roll (CC), down to light (20%) braking line, (DD) and across to read total distance over a 50 ft obstacle = 7000 feet at (EE).
6. Determine minimum allowable RCR with drag chute deployed for 7000 feet of available runway if the uncorrected ground roll is 4500 feet.
 - a. Enter sample ground roll curve at the RCR base line and 4500 foot ground roll, (JJ). Follow the guideline to a ground roll of 7000 feet (KK) and then move left to the RCR scale to read minimum allowable RCR = 8 at (LL).

WARNING

If the reported RCR is less than the calculated minimum RCR as noted on your landing data card, you will not be able to stop on the runway. Divert to an alternate or take action as necessary; such as prepare for barrier engagement or reduce weight.

GROUND ROLL LANDING DISTANCE
HEAVY BRAKING
WITH DRAG CHUTE
SPEED BRAKES OPEN
IDLE THRUST
HARD SURFACE RUNWAY
LE FLAPS — 100%, TE FLAPS — 100%

D

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST

NOTE: IF RCR NOT AVAILABLE, USE:
 DRY-23, WET-12, ICY-5

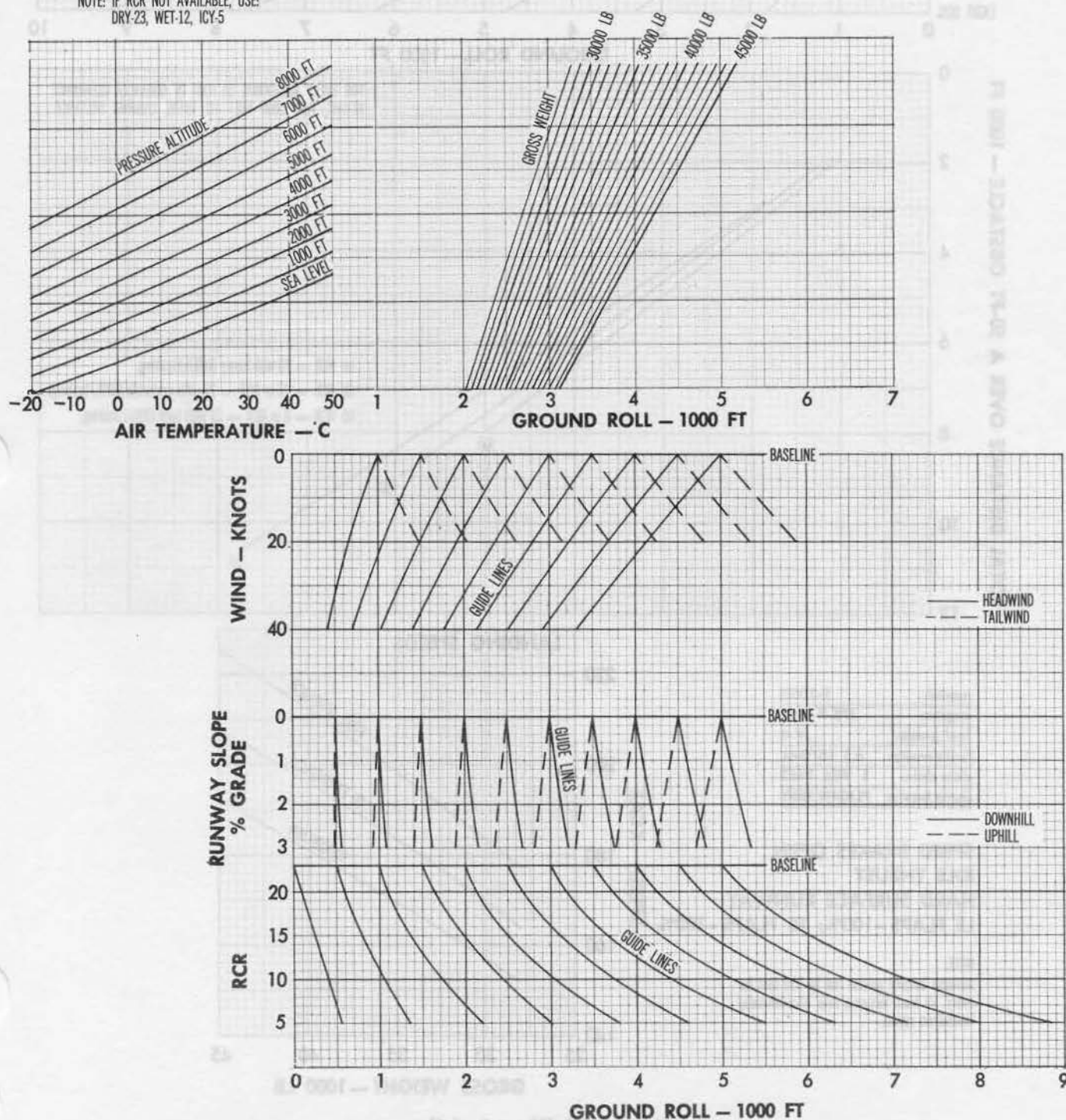
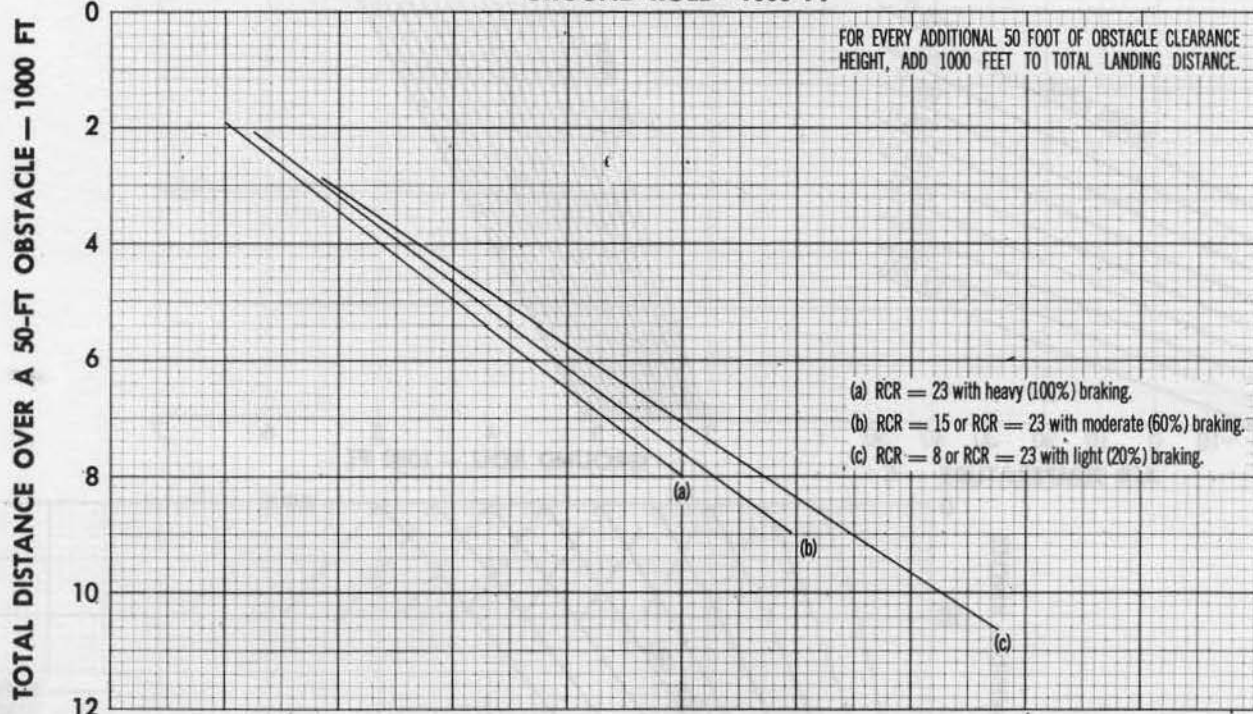
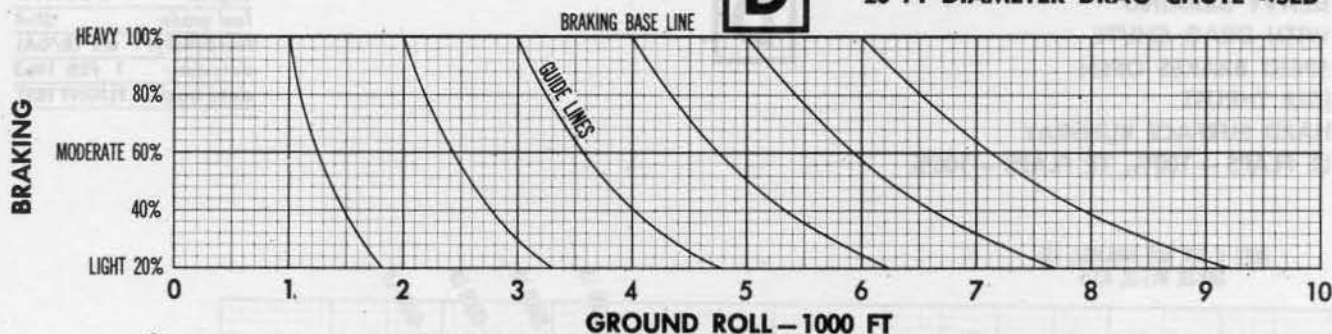


Figure A8-1 (Sheet 1 of 2)



GROUND ROLL LANDING DISTANCE 20 FT DIAMETER DRAG CHUTE USED



model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB 1963
data basis: FLIGHT TEST

**SPEED BRAKES OPEN
IDLE THRUST
HARD SURFACE RUNWAY
LE FLAPS - 100%; TE FLAPS - 100%**

NOTE:

Increase landing ground roll by 350 feet for every 10 knot increase over recommended touchdown speed.

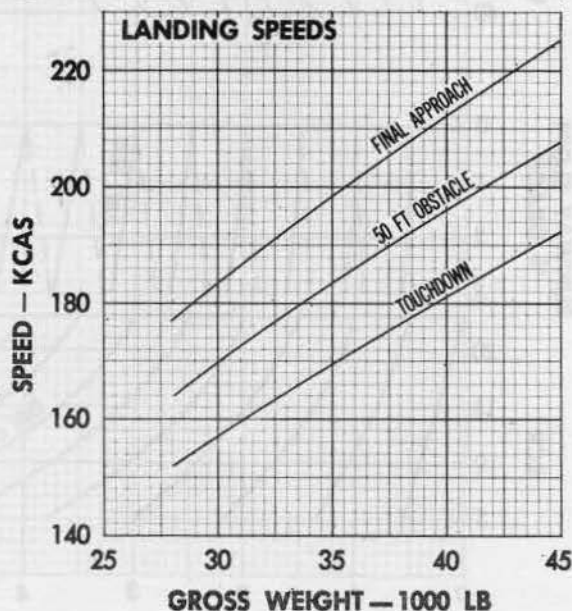


Figure A8-1 (Sheet 2 of 2)

GROUND ROLL LANDING DISTANCE
NO DRAG CHUTE
HEAVY BRAKING
SPEED BRAKES OPEN
IDLE THRUST
HARD SURFACE RUNWAY
LE FLAPS—100%; TE FLAPS—100%

D

model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST

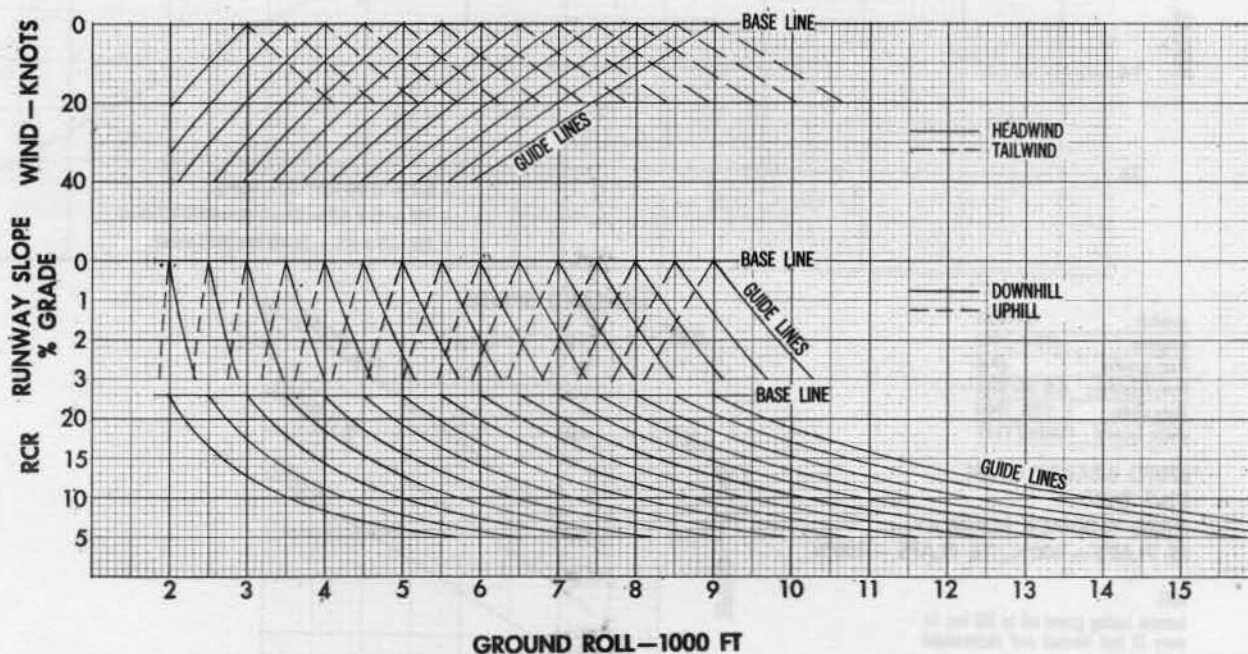
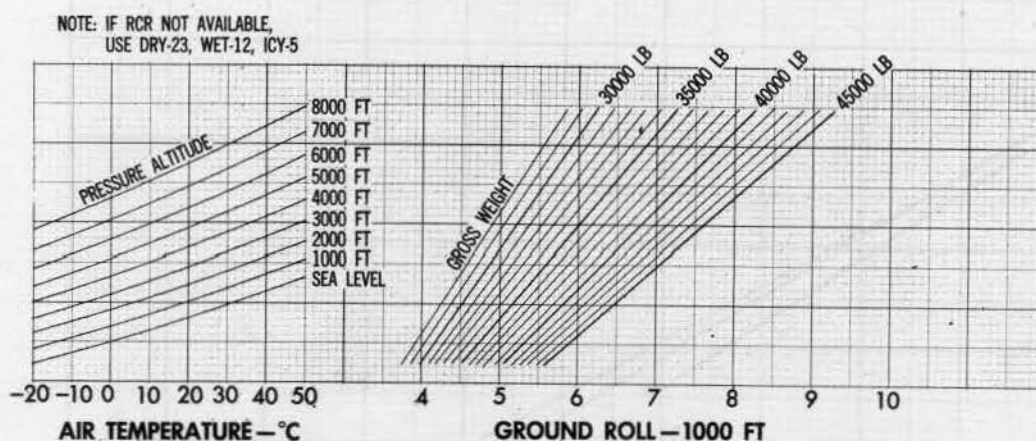
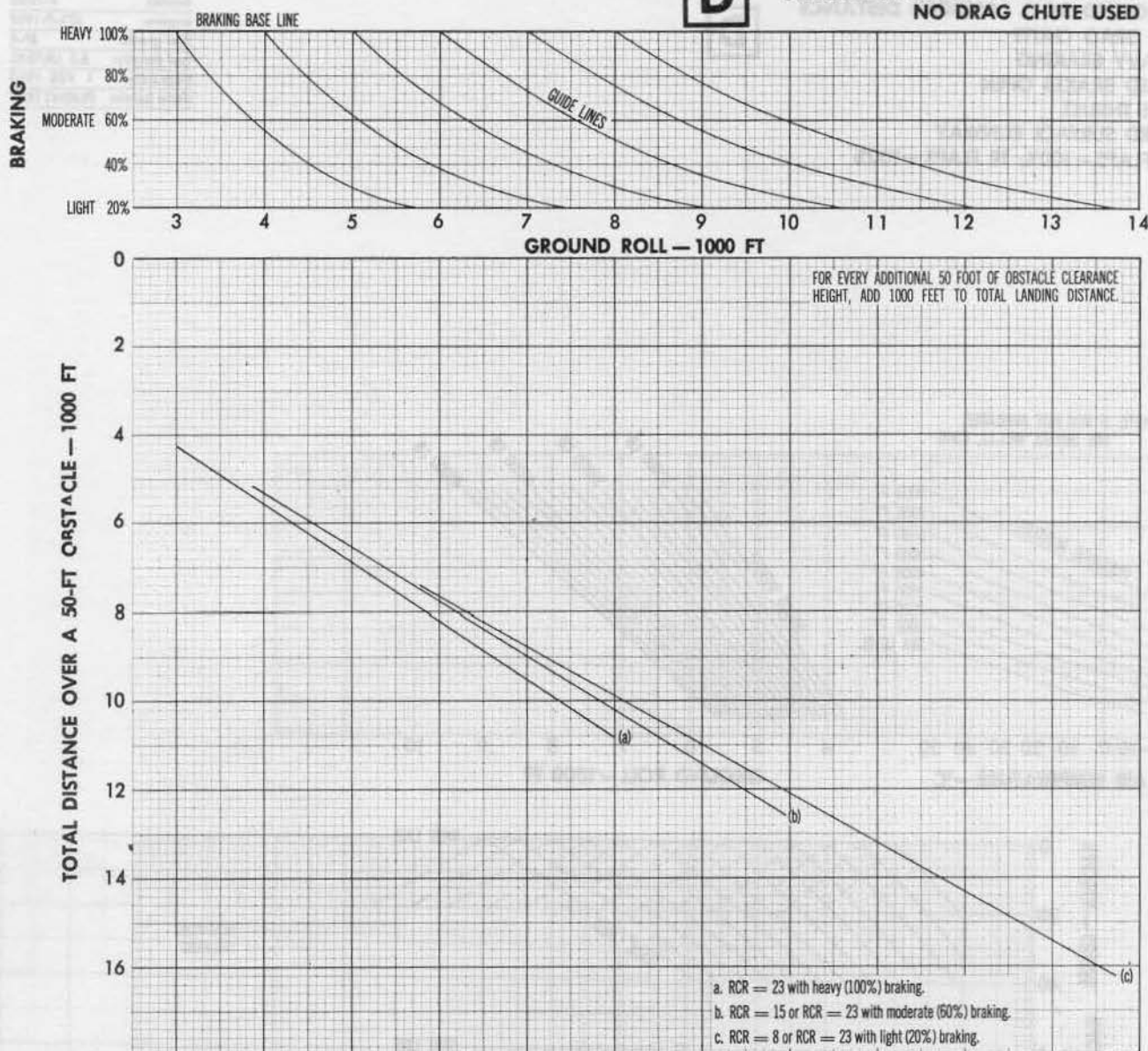


Figure A8-2 (Sheet 1 of 2)

D**GROUND ROLL LANDING DISTANCE
NO DRAG CHUTE USED**

model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB 1963
data basis: FLIGHT TEST

**SPEED BRAKES OPEN
IDLE THRUST
HARD SURFACE RUNWAY
LE FLAPS — 100%, TE FLAPS — 100%**

NOTE:

Increase landing ground roll by 600 feet for every 10 knot increase over recommended touchdown speed.

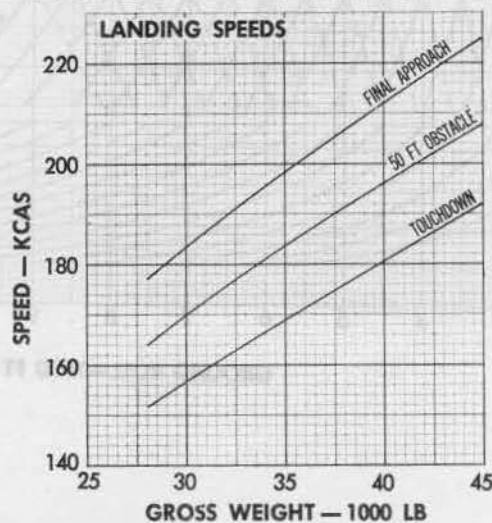


Figure A8-2 (Sheet 2 of 2)

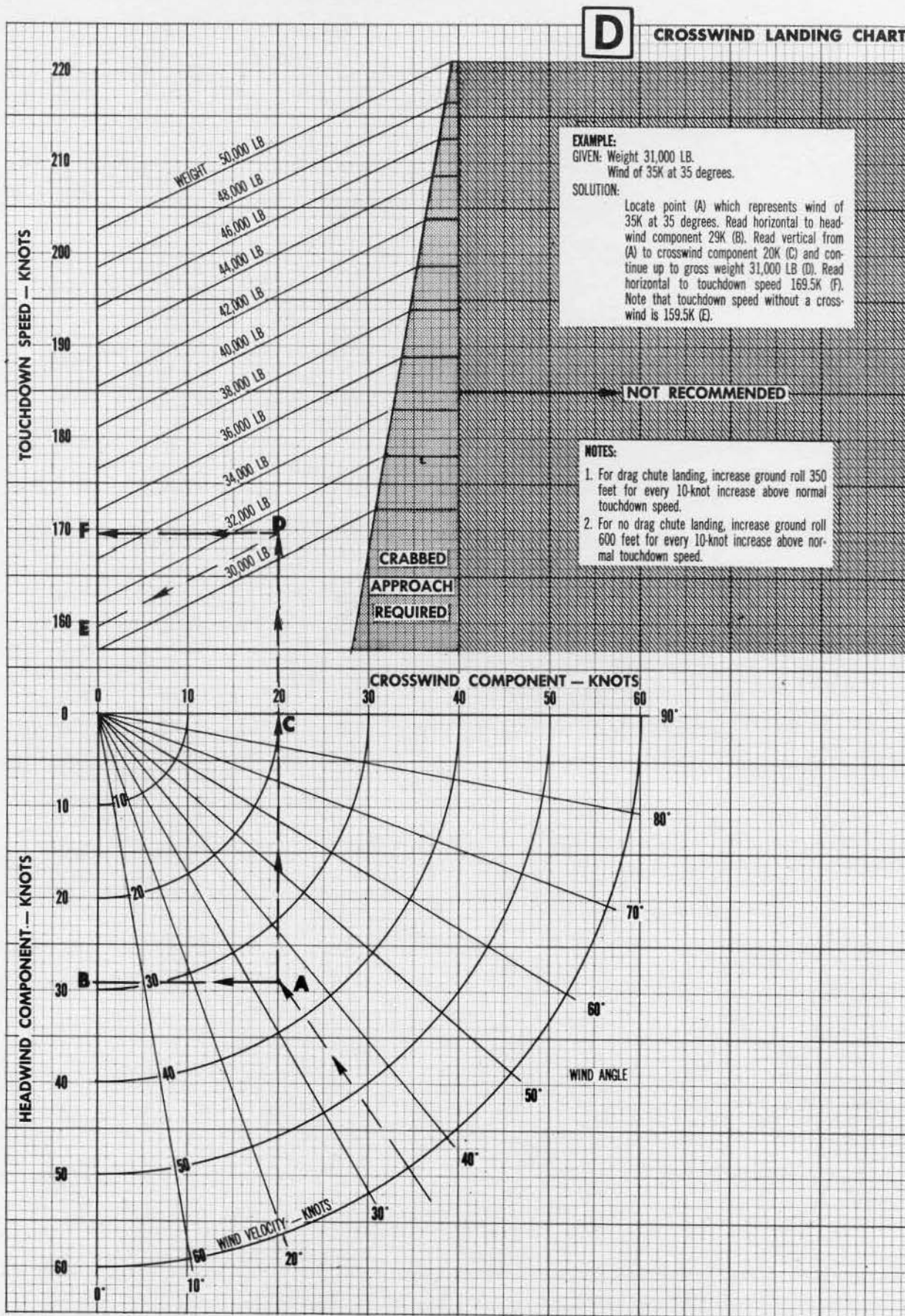


Figure A8-3

PART 9 COMBAT PERFORMANCE

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Combat Allowance Chart	A9-2
Maximum Level Flight Mach Number — Maximum Thrust	A9-5
Maximum Level Flight Mach Number — Military Thrust	A9-6
Maximum Continuous Thrust — Combat Allowance	A9-7

COMBAT ALLOWANCE CHARTS.

Combat Allowance Charts are provided for Maximum and Military Thrust. From these charts the pilot can determine level flight high speed and the fuel required for a specified time or the time available for a given fuel quantity at that speed for any conditions of gross weight, altitude, drag, thrust setting and ambient temperature. Fuel flow rates are also indicated on the charts and can be read for the above conditions or for any speed, altitude, ambient temperature combination.

EXAMPLE I

Conditions: Configuration: Clean + (2) 450 gal. tanks (inboard).

Initial Gross Weight: 44,000 lb

Combat Altitude: 30,000 ft

Combat Thrust Setting: Military

Combat Fuel: 2000 lb

Ambient Temperature: Standard + 5°C

Find: Military High Speed and time available for combat.

Solution:

1. Determine the Configuration Drag Index by

adding the store drag numbers obtained from figure A1-5.

Store	Location	Store Drag NO.
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb'd	14
Configuration Drag Index =		28

2. Determine Average Gross Weight.

Initial Gross Weight = 44,000 lb

Fuel Used in Combat = 2000

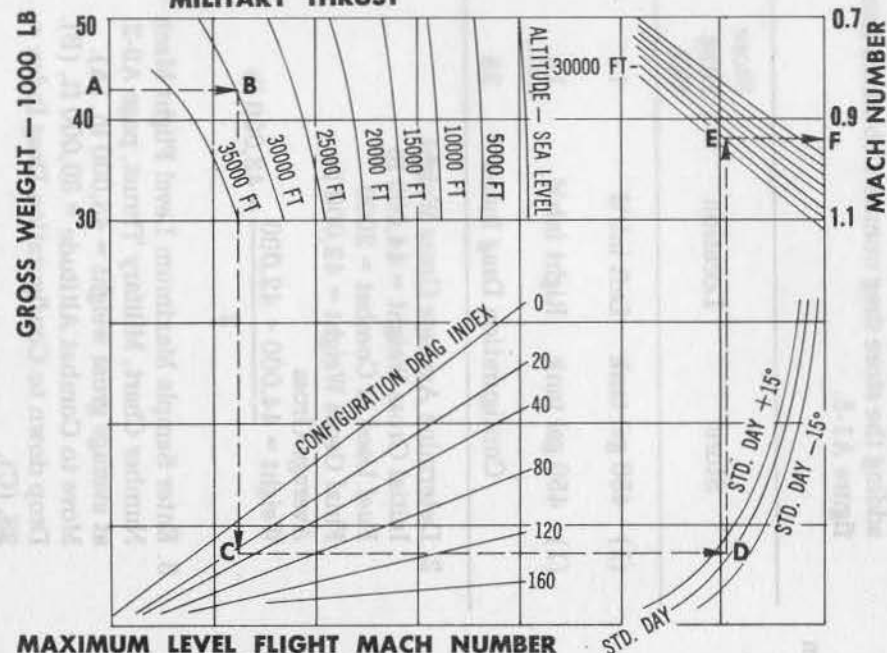
Final Gross Weight = 42,000 lb

Average Gross

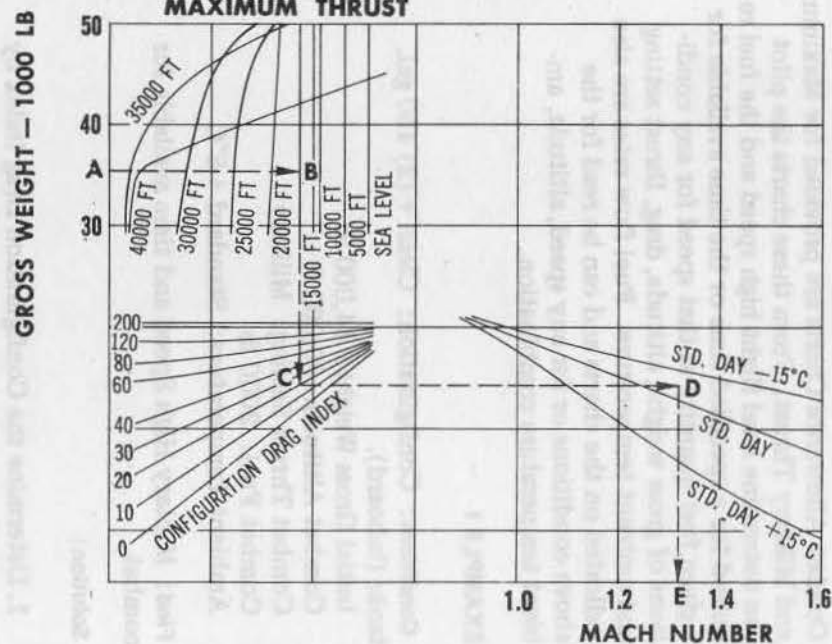
Weight = $\frac{44,000 + 42,000}{2} = 43,000 \text{ lb}$

3. Enter Sample Maximum Level Flight Mach Number Chart, Military Thrust, page A9-2 at average gross weight = 43,000 lb, (A). Move to Combat Altitude = 30,000 ft, (B). Drop down to Configuration Drag Index = 28, (C).

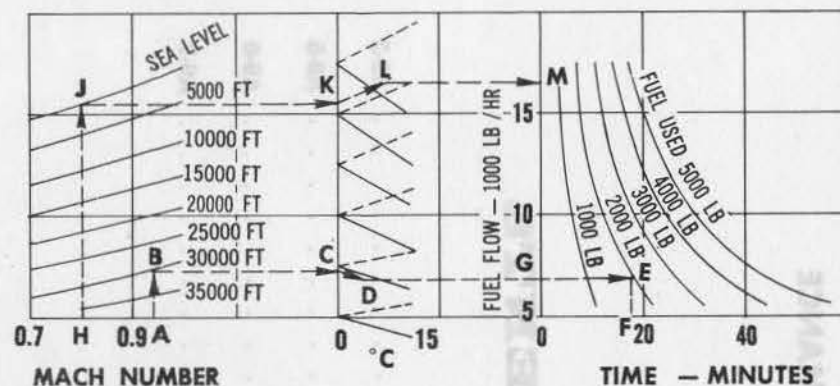
MAXIMUM LEVEL FLIGHT MACH NUMBER MILITARY THRUST



MAXIMUM LEVEL FLIGHT MACH NUMBER MAXIMUM THRUST



COMBAT ALLOWANCE CHART MILITARY THRUST

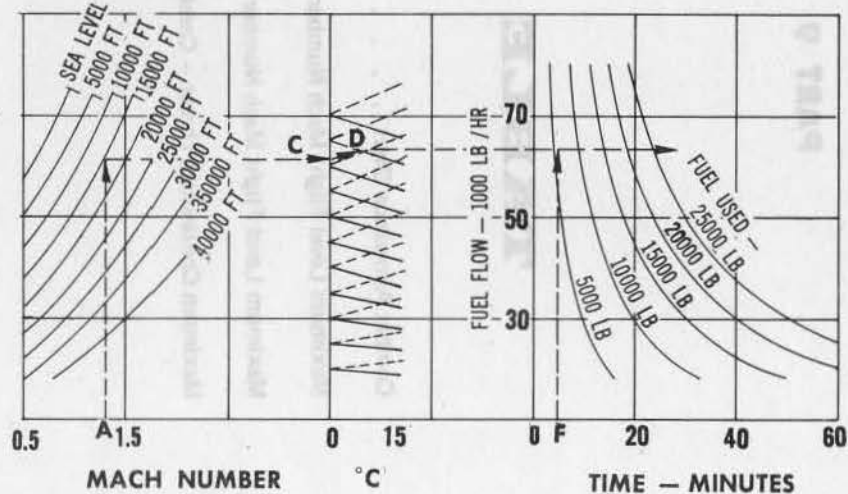


SAMPLE CHART

Not to be used for
Flight Planning



COMBAT ALLOWANCE CHART MAXIMUM THRUST



Move to the right to Standard Day +5°C, (D).
Move up to 3000 ft Altitude Line, (E).
Move across to Mach Number Scale and read
High Speed = 0.94 M, (F).

4. Enter Sample Combat Allowance Chart, Military Thrust, page A9-2 at Combat Mach number = 0.94, (A).
Move up to Combat Altitude = 30,000 ft, (B).
Move to the right to Zero Deviation from Standard Day, at (C).
Follow the solid (hotter) guide lines to 5°C deviation, (D).
Move across to the 2000 lb Fuel Used line, (E).
Drop to the time scale and read time available = 17.5 min, (F).
If fuel flow is required, read fuel flow scale at (G) = 6850 lb/AR.

EXAMPLE II

Conditions: Configuration: Clean + (2) AGM-12B Missiles, outboard.

Initial Gross Weight: 38,000 lb
Combat Altitude: 15,000 ft
Combat Thrust Setting: Maximum
Combat Time: 5 Min
Ambient Temperature: Standard -5°C

Find: Maximum Thrust High Speed and fuel required for combat.

Solution:

1. Determine the Configuration Drag Index by adding the store drag numbers obtained from figure A1-5.

Store	Location	Store Drag NO.
(1) AGM-12B	Left outb'd	10
(1) AGM-12B	Right outb'd	10
Configuration Drag Index =		20

2. Estimate Average Gross Weight.
Initial Gross Weight = 38,000 lb
Estimated Combat Fuel = 5000 lb
Estimated Final Gross Weight = 33,000 lb
Estimated Average
Gross Weight = $\frac{38,000 + 33,000}{2} = 35,500$ lb

3. Enter Sample Maximum Level Flight Mach Chart, Maximum Thrust, page A9-2 at Estimated Average Gross Weight = 35,500 lb, (A).
Move to Combat Altitude = 15,000 ft, (B).
Drop down to Configuration Drag Index = 20, (C).
Move across to Standard Day - 5°C, (D).
Drop down to Mach Number Scale and read high speed = 1.32 Mach number, (E).
4. Enter Sample Combat allowance Chart, Maximum Thrust, page A9-2 at Combat Mach number = 1.32, (A).
Move up to Combat Altitude = 15,000 ft, (B).
Move to the right to Zero Deviation from Standard Day, at (C).
Follow the dashed (colder) guide lines to 5°C deviation, (D).
Construct a Horizontal line from (D), (DE).
Enter the time scale at 5 minutes, (F).
Move up to intersect line (DE) at (G) and read fuel required for combat = 5250 lb.
5. Revising the Estimated Average Gross Weight and reworking the computation will result in the same readings.

EXAMPLE III

Conditions: Combat Altitude: Sea Level.
Combat Speed: 0.8 Mach number
Combat Thrust Setting: Military
Ambient Temperature: Standard +10°C.

Find: Fuel Flow and fuel required for 5 minutes of combat.

Note

This example assumes that level flight high speed has already been determined for the gross weight and Configuration conditions, and that 0.8 Mach number does not exceed Military Thrust capability.

Solution:

1. Enter sample Combat Allowance Chart, Military Thrust, page A9-2 at lower left hand corner at Mach number = 0.8, (H).
2. Move up to the Sea Level line, (J).
3. Move to the left to Zero Deviation from Standard Day at (K).

4. Follow the solid (hotter) guide lines to 10°C Deviation, (L).
5. Move horizontally to the Fuel flow scale and

read Fuel Flow = 16,600 lb/HR, (M).

6. Fuel required for 5 minutes = lb/HR × 5 Min/
60 Min = 16,000 × 1/12 = 1383 lb.

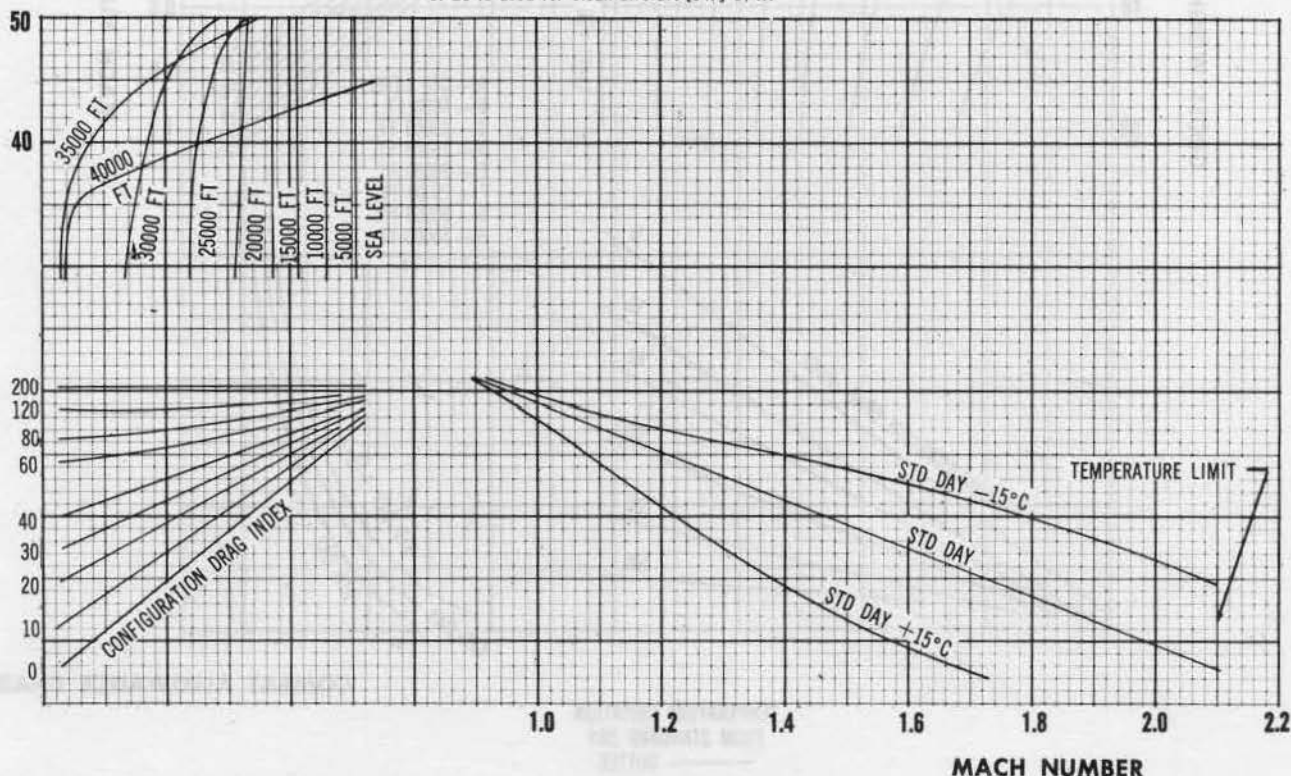
MAXIMUM LEVEL FLIGHT MACH NUMBER MAXIMUM THRUST



Model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB. 1963
data basis: FLIGHT TEST

Maximum level flight Mach Numbers will be significantly conservative if a drag number of 20 is used for clean aircraft [947] C/W.

GROSS WEIGHT — 1000 LB



COMBAT ALLOWANCE CHART

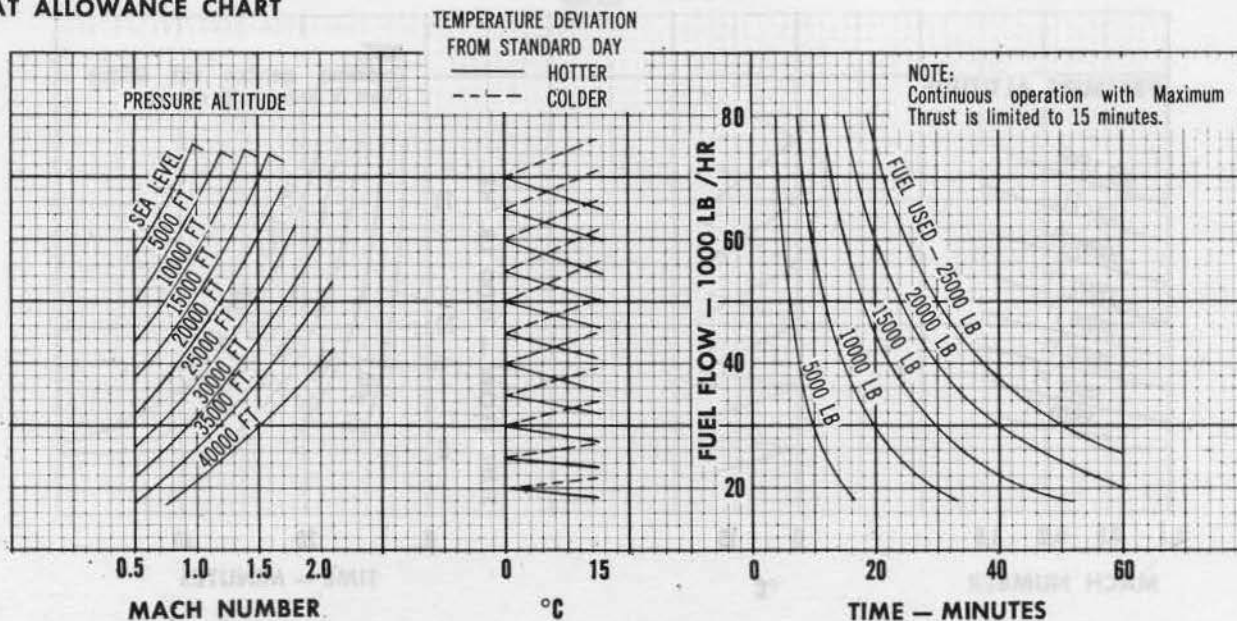


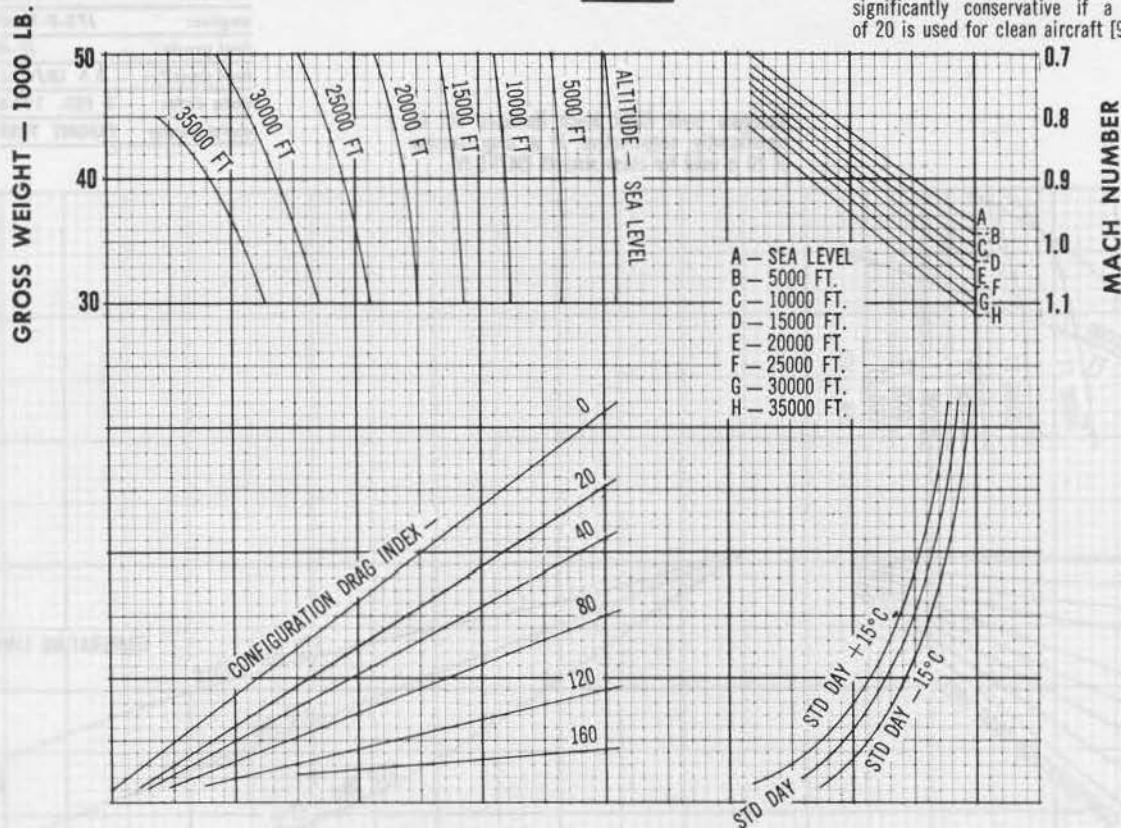
Figure A9-1

Model: F-105D
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB. 1963
 data basis: FLIGHT TEST

D

MAXIMUM LEVEL FLIGHT MACH NUMBER MILITARY THRUST

Maximum level flight Mach Numbers will be significantly conservative if a drag number of 20 is used for clean aircraft [947] C/W.



COMBAT ALLOWANCE CHART

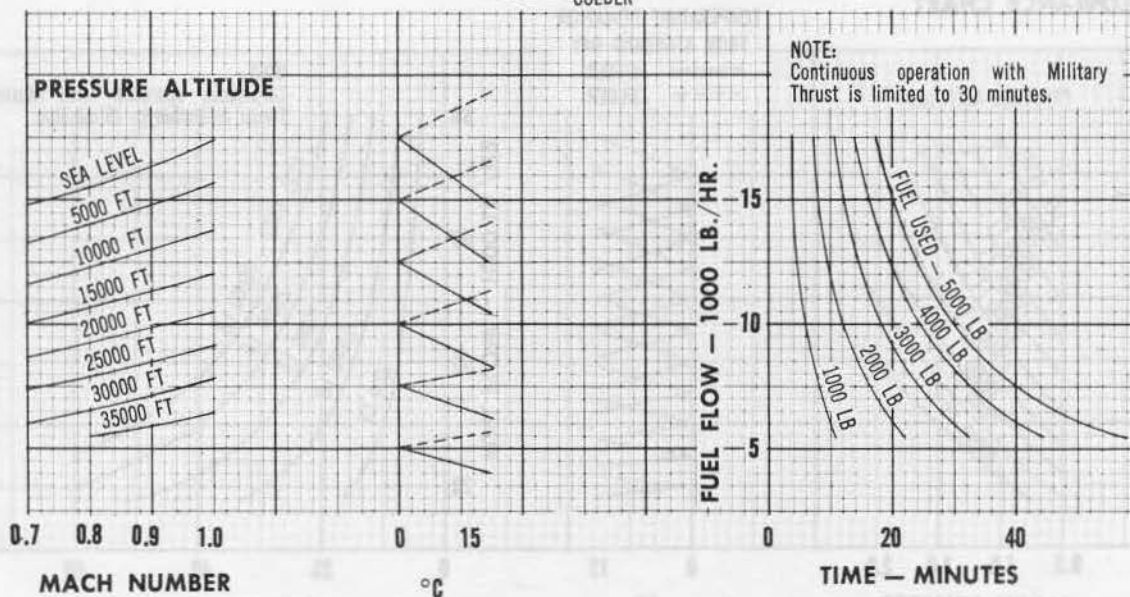


Figure A9-2

MAXIMUM CONTINUOUS THRUST COMBAT ALLOWANCE STANDARD DAY

Model: F-105D
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 FEB. 1963
data basis: FLIGHT TEST

Maximum level flight Mach Numbers will be significantly conservative if a drag number of 20 is used for clean aircraft (947) C/W.

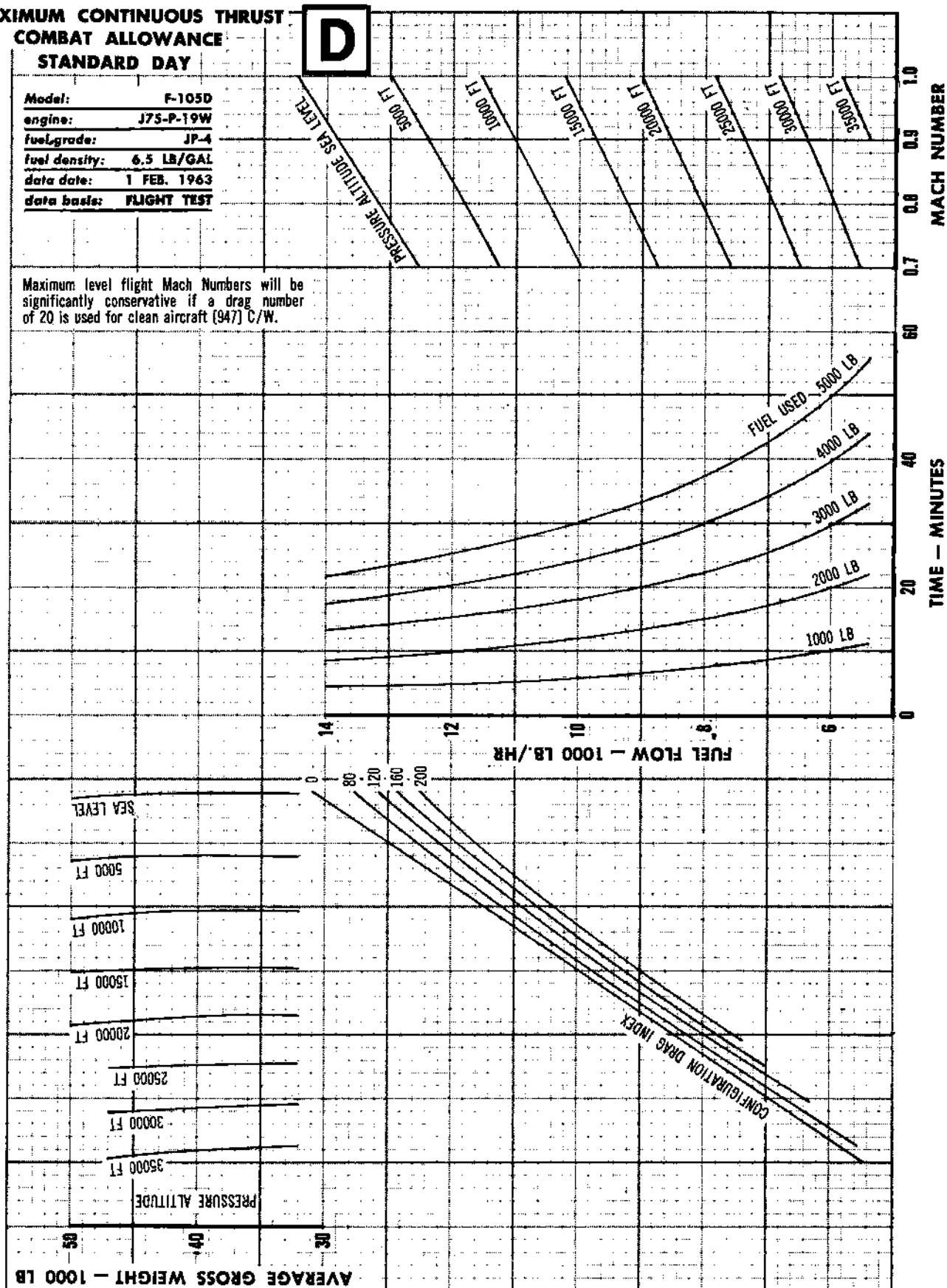


Figure A9-3

PART 10 MISSION PLANNING

INTRODUCTION.

The scope of mission planning can be enhanced through the drag count concept, since all combat missions can be computed for any possible combination of store loadings. Therefore, a thorough knowledge of the methods of using these charts can be an important tool in flight operations. By actually working through a precise combat mission, a more thorough understanding of the applicable charts will be attained. Figures A10-1 through A10-4 show the use of the performance charts for a number of specific missions.

RULES OF THUMB.

As an additional guide to Mission Planning, the following rules of thumb for range variation due to fuel loading, cruise altitude and low altitude dash are offered. It should be noted that these are very rough estimates to enable the mission planner to determine the approximate configuration and flight plan required to complete a given mission. Large variations from these estimates occur for differences in Drag, Aircraft Weight, Combat Allowances, High Speed Runs, Altitudes flown, Weather Conditions, etc. Once the rules of thumb have been applied to give an order of magnitude, a precise mission calculation must be performed to determine the actual radius or range values. The use of these approximations and some of the variation from actual mission computations are illustrated in the precise mission planning sections.

1. Approximate Radius of Action for Fuel.

Fuel Loading	General Profile		
	High Altitude N.Mi.	Low Altitude N.Mi.	Lo-Hi N.Mi.
Normal Internal	220	110	155
Add for Bomb Bay Tank	130	65	90
Full Internal	350	175	245
*Add for Wing Tanks (2)	300	150	210
*Add for 650 Gal CL	200	100	140

*Dropped when empty

2. Approximate Trade-Off of Low Altitude Cruise For High.

One and a half to two nautical miles of high altitude cruise range can be achieved for every nautical mile of low altitude cruise range.

EXAMPLE:

Problem: 425 NMi has been established for a Lo-Lo cruise radius of action for a particular configuration and profile. In order to attack a target 500 NMi from base and return, how many miles must be flown at high altitude? (Hi-Lo-Lo-Hi).

Estimate: One hundred nautical miles of low altitude cruise is equivalent to approximately 175 miles at high altitude. Therefore, reduce lo-lo portion by 100 NMi radius of action and substitute 175 NMi of hi-hi radius.

Total Radius of Action: $425 - 100 = 325$ Lo-Lo
 $+ 175$ Hi-Hi = 500 NMi Estimated R/A

3. Approximate Trade-Off of Low Altitude Cruise For Low Altitude Dash.

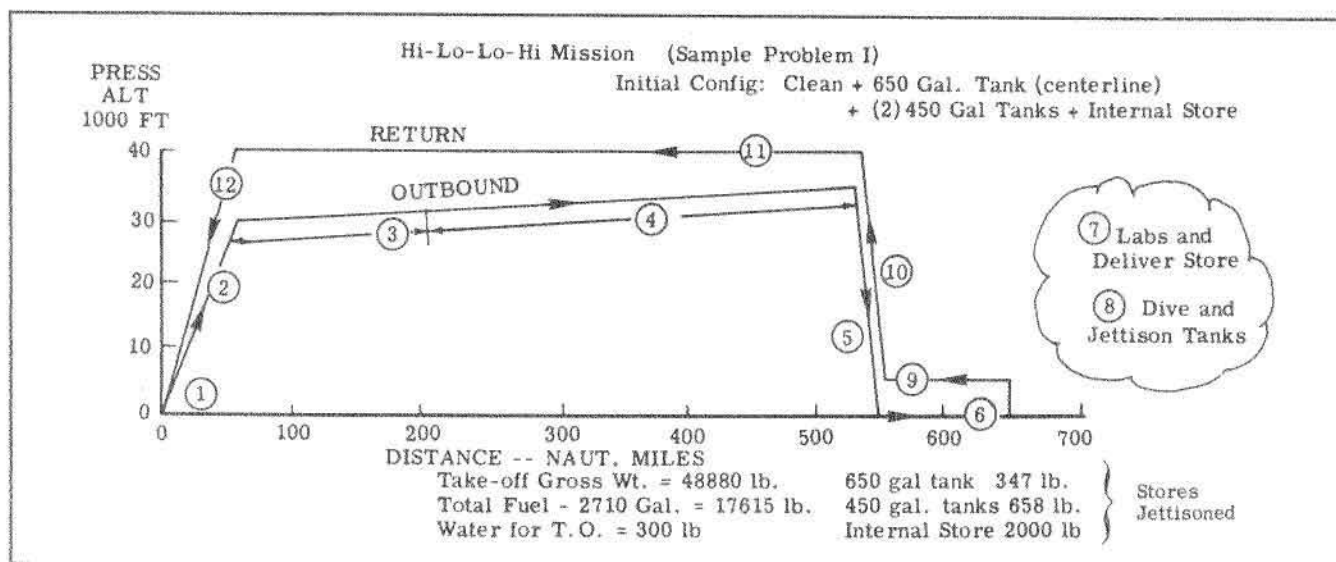
The trade-off of cruise for dash at low altitude depends large on configurations and speeds. However, the following is a broad generalization of the effect of substituting non-afterburning dash at low altitude for low altitude cruise: Allow 2/3 of a nautical mile in dash for every nautical mile in cruise.

EXAMPLE:

Problem: What would the Hi-Lo-Lo-Hi radius of action shown above become if the low portions were flown at 0.9 Mach number at Sea Level?

Estimate: 325 Lo-Lo cruise $\times 2/3 = 217$ Lo-Lo dash at 0.9 M.

Total Radius of Action: 217 Lo-Lo at 0.9M
 $+ 175$ Hi-Hi = 392 NMi Estimated R/A



Step	Operation	Config. Drag Index	Leg Fuel Used	Sum Fuel Used	Fuel Remaining	Final Gross Weight	Alt. at End of Step	Leg Time	Sum Time	Leg Dist.	Sum Dist.
			LB.	LB.	LB.	LB.	FT.	MIN.	HR:MIN	N. MI.	N. MI.
	Initial Configuration		0	0	17615	48880			0		0
1	Taxi, Take-Off and Accelerate to Climp Speed*		1500	1500	16115	47080	S. L.	1	0:01	-	0
2	Military Thrust Climb to Initial Cruise-Climb Alt.	52	1680	3180	14435	45400	29600	10	0:11	84	84
3	Cruise-Climb Jettison Centerline Tank	52	1045	4225	13390	44355 44008	30400	11	0:22	97	181
4	Cruise-Climb	28	3100	7325	10290	40908	32400	38	1:00	323	504
5	Combat Descent to S. L.	28	115	7440	10175	40793	S. L.	6	1:06	46	550
6	Dash-In at 0.9 M at S. L.	28	2350	9790	7825	38443	S. L.	10	1:16	100	650
7	Labs Maneuver and Deliver Store	28	250	10040	7575	38193 36193	12000	1	1:17	-	-
8	Dive (30°) to S. L. and Jettison Wing Tanks	0	80	10120	7495	35455	S. L.	1	1:18	-	-
9	Dash-Out at 0.9 M at S. L.	0	2028	12148	5467	33427	S. L.	10	1:28	100	750
10	Military Thrust Climb to Initial Return CR-CL Alt.	0	920	13068	4547	32507	37600	6	1:34	53	803
11	Cruise Climb	0	2640	15708	1907	29867	39250	49	2:23	411	1214
12	Maximum Range Descent to S. L.	0	274	15982	1633	29593	S. L.	15	2:38	86	1300

*Reduce Weight 300 Lb. for Water

Figure A10-1

SAMPLE PROBLEM I: HI-LO-LO-HI MISSION PLAN**Mission Rules:**

A combat mission is to be flown at long range speeds and altitudes, carrying drop tanks and an internal store. Within 100 nautical miles of the target, a run-in is to be performed at tree top level at 0.9 Mach number, and the store delivered at the top of a LABS Maneuver. After a 30° dive from the recovery altitude, run back 100 nautical miles from target. The drop tanks are to be jettisoned when empty. Prepare a flight plan for a target 650 nautical miles from the air base.

Weather Conditions:

Standard Day, no wind.

Configuration: [947] N/C/W

Clean + 650 gallon tank (centerline) + (2) 450 gallon tanks (inboard) + internal store.

Weights: (figure A1-5).

Clean Aircraft without B/B/ tank. 35,500 LB
(7540 LB fuel)

650 gal tank (centerline) 347 LB

(2) 450 gal tanks 658 LB

External fuel
(650 + 900 GAL = 4225 + 5850 LB) . . . 10,075 LB

Internal Store 2,000 LB

Water for Take-Off 300 LB

Take-Off Gross Weight 48,880 LB

Total fuel on board (7540 + 10,075) . . . 17,615 LB

Computation:**Step 1. Take-Off.**

Assume that 1500 pounds of fuel, one minute and 300 pounds of water are used for take-off and acceleration to climb speed.

Gross weight after take-off
(48,880 - 1500 - 300) 47,080 LB

Time Elapsed 1.0 MIN

Fuel Remaining (17,615 - 1500) 16,115 LB

Step 2. Military Thrust Climb to Cruise-Climb Altitude.**A. From figure A1-5 determine the initial configuration drag index.**

650 GAL tank (centerline) 24

(2) 450 GAL tanks (inboard) 28

Initial Configuration Drag Index 52

Note

Configuration Drag Index changes whenever external tanks, bombs and/or pylons are jettisoned.

B. From figure A3-6 read

1. Fuel Used 1680 LB

2. Distance Covered 84 NMi

3. Time Elapsed 10 MIN

C. 1. Final Gross Weight (47,080 - 1680) 45,400 LB

2. Fuel Remaining (16,115 - 1680) . . . 14,435 LB

D. To determine the level-off altitude at the end of climb, enter "Optimum Cruise Altitude" Chart, Figure A3-7, at a gross weight of 45,400 LB (step 2-C-1) and Configuration Drag Index 52 and read the initial cruise-climb altitude = 29,600 FT.**Step 3. Outboard Cruise (first leg).****A. Use figure A4-3 for Cruise-Climb Performance.**

1. Cruise with fuel remaining in centerline tank (4225 - 1500 - 1680) 1045 LB

2. Compute Average Gross Weight
45,400 - (1045 ÷ 2) 44,878 LB

3. From figure A4-3 "Optimum Cruise Altitude" read altitude at the average gross weight during cruise 30,000 FT

4. From figure A1-10, read Standard Day temperature at 30,000 ft pressure altitude -44.4°C

5. From figure A4-3 Mach number for cruise 0.88 M

6. Time to cruise 11.4 MIN

7. Cruise distance 97 NMi

8. Final Gross Weight (45,000 - 1045) 44,355 LB

9. Fuel Remaining (14,435 - 1045) .. 13,390 LB

B. Jettison Centerline Tank

1. Final Gross Weight (44,355 - 347) 44,008 LB

2. New Configuration Drag Index (figure A1-5 (2) 450 GAL tanks , 28

Step 4. Outboard Cruise (2nd leg)

A. Determine outboard cruise distance. Since the flight plan calls for a radius of action of 650 nautical miles and the outboard distance is a combination of climb, cruise, descent and dash 100 NMi at Sea Level, estimate the descent distance.

1. Estimate a weight at start of descent as:

Final Gross Weight after centerline tank is jettisoned 44,008 LB

2. Configuration Drag Index 28

3. From figure A4-3 "Optimum Cruise Altitude" read final cruise climb altitude 31,000 FT

4. From figure A7-2 distance to descend 46 NMi

5. Compute cruise distance remaining (650 - 84 - 97 - 46 - 100) 323 NMi

B. Use figure A4-3 for Cruise-climb performance.

1. Estimate fuel used to cruise 323 NMi 2000 LB

2. Compute estimated average gross weight $44,008 - (2000 \div 2)$ 43,008 LB

3. From figure A4-3 "Optimum Cruise Altitude" read altitude for the average gross weight during cruise ... 31,500 FT

4. From figure A1-10 read Standard Day Temperature at 31,500 FT pressure altitude -47.4°C

5. From figure A4-3 Fuel used to cruise 323 NMi ... 3100 LB

C. Since the estimated fuel does not equal the computed fuel

1. Re-estimate average gross weight: $44,008 - (3100 \div 2)$ 42,458 LB

2. Re-read average cruise altitude from figure A4-3 31,750 FT

3. Read Standard Day Temperature at 31,750 ft pressure altitude ... -47.9°C

4. From figure A4-3 Fuel used to cruise 323 NMi ... 3100 LB

5. Mach number for cruise 0.89 M

6. Time to cruise 37.5 MIN

7. Final Gross Weight (44,008 - 3100) 40,908 LB

8. Fuel Remaining (13,390 - 3100) . 10,290 LB

9. From figure A4-3 "Optimum Cruise Altitude", final cruise altitude 32,400 FT

Step 5. Combat Descent to Sea Level (0.9 Mach or 400 KCAS whichever is less)

A. From figure A7-2

1. Distance to descent 46 NMi

2. Fuel used in descent 115 LB

3. Time elapsed in descent 5.8 MIN

4. Final gross weight (40,908 - 115) 40,793 LB

5. Fuel remaining (10,290 - 115) 10,175 LB

- B. Since the combat descent distance of step 5 is the same as that estimated in step 4, the mission can be continued into the next step. However, if the descent distance of step 5 varied from the estimate of step 4, then the last leg of the cruise portion would be changed by the same increment.

Step 6. Dash-In (100 Nautical Miles at 0.9 Mach number)

- A. Estimate the fuel used for 100 nautical mile run in

1. Estimate dash fuel (fuel remaining in wing tanks) 5850 - 3100 - 115) 2635 LB

2. Estimate Average Gross Weight:
40,793 - (2635 ÷ 2) 39,475 LB

3. Ambient Temperature at S.L.
(figure A1-10) 15°C

4. From figure A4-4 read true airspeed
at 0.9 Mach number at 15°C 595 KN

5. From figure A4-4 read fuel
flow 14,000 LB/HR

6. Compute time required to dash
100 NMi (Dist ÷ Speed = Time)
100 ÷ 595) = 0.168 HR

7. Compute fuel required (fuel flow x
time) 14,000 x 0.168 2350 LB

- B. Since the estimated fuel does not equal the computed fuel

1. Re-estimate average gross weight
40,793 - (2350 ÷ 2) 39,618 LB

2. Read fuel flow from
figure A4-4 14,000 LB/HR

3. Since time and fuel flow have not changed,
steps 6A6 and 7 do not have to be re-done

4. Time in minutes
(0.168 HR x 60 MIN/HR 10.1 MIN

5. Final gross weight (40,793-2350). . 38,443 LB

6. Fuel remaining (10,175 - 2350) . . . 7825 LB

Step 7. Labs Maneuver (Bomb Delivery)

Allow approximately 250 pounds of fuel and one minute, with recovery at 12,000 FT for this maneuver.

1. Final gross weight
(38,443 - 250 - 2000*) 36,193 LB

2. Fuel remaining (7825 - 250) 7575 LB

3. Time elapsed 1 MIN

Step 8. Perform a 30° Dive to Sea Level and Jettison the (2) 450 gallon tanks.

- A. Allow approximately 80 pounds of fuel and half a minute for this maneuver

1. Final Gross Weight
(36,193 - 658* - 80) 35,455 LB

2. Fuel remaining (7575 - 80) 7495 LB

3. Time Elapsed 0.5 MIN

*Weight of tanks

- B. From figure A1-5, new Configuration Drag Index for the clean Aircraft = 0

Step 9. Dash-Out (100 Nautical Miles at 0.9 Mach number)

- A. Use figure A4-4 for Dash Performance

1. Estimate dash fuel 2350 LB

2. Estimate average gross weight:
35,455 - (2350 ÷ 2) 34,280 LB

3. Ambient temperature at S.L. 15°C

4. From figure A4-4 read true airspeed at
0.9 Mach at 15°C 595 Knots

5. From figure A4-4 read fuel
flow 12,070 LB/HR

6. Compute time required to dash 100
NMi (dist ÷ speed = time)(100 ÷ 595) 0.168 HR

7. Compute fuel required (fuel flow x
time) 12,070 x 168) 2028 LB

B. Since the estimated fuel does not equal the computed fuel,

1. Re-estimate average gross weight
 $35,455 - (2028 \div 2) \dots\dots\dots 34,441 \text{ LB}$
2. Read fuel flow $\dots\dots\dots 12,070 \text{ LB/HR}$
3. Since time and fuel flow have not changed, steps 9A6 and 7 do not have to be re-done
4. Time in minutes
 $(0.168 \text{ HR} \times 60 \text{ MIN/HR}) \dots\dots\dots 10.1 \text{ MIN}$
5. Final gross weight $(35,455 - 2028) \dots\dots\dots 33,427 \text{ LB}$
6. Fuel remaining $(7495 - 2028) \dots\dots\dots 5467 \text{ LB}$

Step 10. Military Thrust Climb to Return-Cruise-Climb Altitude

A. From figure A3-5 read the climb performance

Fuel used $\dots\dots\dots 920 \text{ LB}$
 Distance covered $\dots\dots\dots 53 \text{ NMi}$
 Time elapsed $\dots\dots\dots 6 \text{ MIN}$

1. Final Gross weight $(33,427 - 920) \dots\dots\dots 32,507 \text{ LB}$
2. Fuel remaining $(5467 - 920) \dots\dots\dots 4547 \text{ LB}$

Step 11. Determine return Cruise Distance

A. Since the return distance must equal 650 NMi including return dash, climb, cruise and descent, estimate a descent distance

1. Estimate a weight at start of descent as: $(\text{Weight at end of climb} + \text{empty weight}) \div 2$
 $(32,507 + 27,960) \div 2 \dots\dots\dots 30,234 \text{ LB}$
2. From figure A4-3 "Optimum Cruise Altitude" read final cruise-climb altitude based on Estimated Weight $\dots\dots\dots 39,100 \text{ FT}$
3. From figure A7-1 read descent distance $\dots\dots\dots 86 \text{ NMi}$
4. Compute cruise distance
 $(650 - 100 - 53 - 86) \dots\dots\dots 411 \text{ NMi}$

B. Use figure A4-3 for cruise-climb performance

1. Estimate fuel used to cruise
 $411 \text{ NMi} \dots\dots\dots 3000 \text{ LB}$
2. Compute average gross weight:
 $32,507 - (3000 \div 2) \dots\dots\dots 31,007 \text{ LB}$
3. From figure A4-3 "Optimum Cruise Altitude" read the altitude for the average gross weight during cruise $\dots\dots\dots 38,600 \text{ FT}$
4. From figure A1-10 read Standard Day temperature at 38,600 FT pressure altitude $\dots\dots\dots -56.5^\circ\text{C}$
5. From figure A4-3 fuel used to cruise 411 NMi $\dots\dots\dots 2640 \text{ LB}$

C. Since the estimated fuel does not equal the computed fuel

1. Re-estimate average gross weight
 $32,507 - (2640 \div 2) \dots\dots\dots 31,187 \text{ LB}$
2. Re-read average cruise altitude from figure A4-3 $\dots\dots\dots 38,500 \text{ FT}$
3. Read temperature at 38,500 FT pressure altitude $\dots\dots\dots -56.5^\circ\text{C}$
4. From figure A4-3 fuel used to cruise 411 NMi $\dots\dots\dots 2640 \text{ LB}$
5. Mach number for cruise $\dots\dots\dots 0.895 \text{ M}$
6. Time to cruise $\dots\dots\dots 48.5 \text{ MIN}$
7. Final gross weight
 $(32,507 - 2640) \dots\dots\dots 29,867 \text{ LB}$
8. Fuel remaining $(4547 - 2640) \dots\dots\dots 1907 \text{ LB}$
9. From figure A4-3 "Optimum Cruise Altitude" read final cruise altitude $\dots\dots\dots 39,250 \text{ FT}$

Step 12. Maximum Range Descent

A. From figure A7-1 read distance to descent $\dots\dots\dots 86 \text{ NMi}$

Note: Since the descent distance of step 11A is the same as that used in step 12A, the mission can be continued.

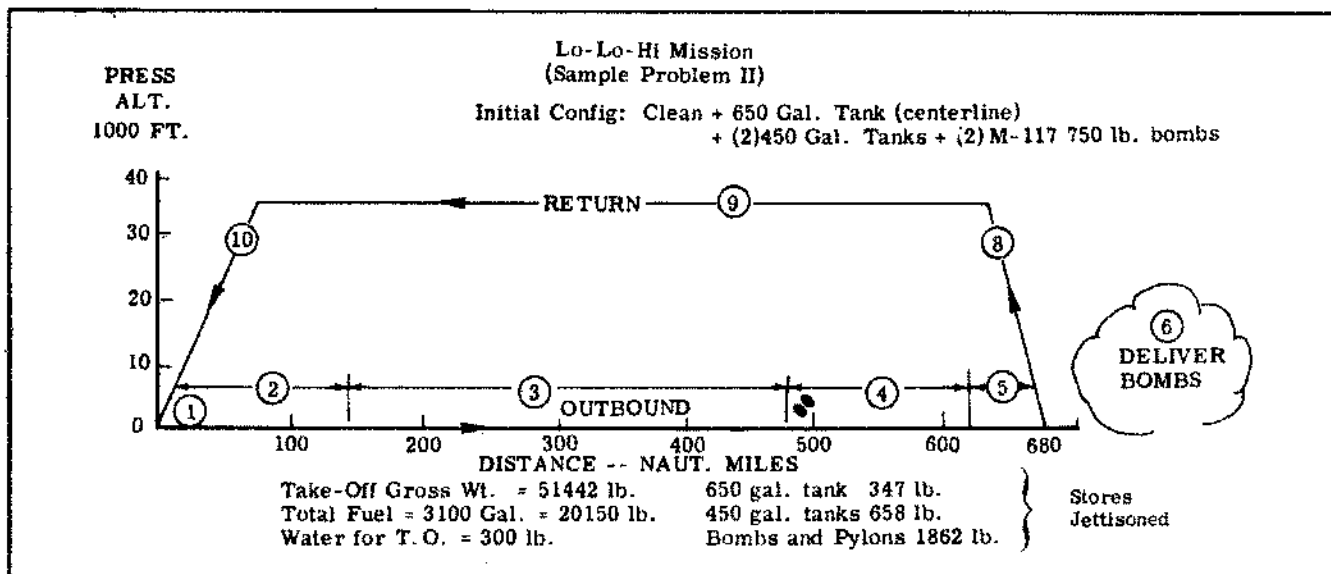
1. From figure A7-1
fuel used to descend 274 LB
2. Time elapsed in descent 1.45 MIN
3. Final Gross Weight (29,867-274) .. 29,593 LB
4. Fuel remaining (1907 - 274) 1633 LB

Steps 13. Summary of Performance

Radius of Action 650 NMi

Time 2 HR + 38 MIN

Fuel remaining for landing reserve .. 1633 LB



Step	Operation	Config. Drag Index	Leg Fuel Used	Sum Fuel Used	Fuel Remaining	Final Gross Weight	Alt. at End of Step	Leg Time	Sum Time	Leg Dist.	Sum Dist.
			LB.	LB.	LB.	LB.	FT.	MIN.	HR: MIN.	N. MI.	N. MI.
	Initial Condition			0	20150	51442			0		0
1	Taxi, Take-off and Accelerate to Cruise Speed*		1500	1500	18650	49642	S. L.	1	0:01	0	0
2	Outbound Cruise (Use Centerline Tank) Jettison Centerline Tank	84	2725	4225	15925	46917	S. L.	21	0:22	143	143
3	Outbound Cruise (Use Wing Tanks) Jettison Wing Tanks.	60	5850	10075	10075	40720	S. L.	50	1:12	336	479
4	Outbound Cruise	26	2310	12385	7765	37752	S. L.	23	1:35	151	630
5	Dash at S. L. at 0.9 Mach	26	1110	13495	6655	36642	S. L.	5	1:40	50	680
6	Lay Down Delivery of Bombs	26	280	13775	6375	34500	S. L.	1	1:41		
7**											
8	Military Thrust Climb to 35,000 Ft.	0	790	14565	5585	33710	35000	5	1:46	41	721
9	Return Cruise	0	3900	18465	1685	29810	35000	70	2:56	565	1286
10	Maximum Range Descent to S. L.	0	250	18715	1435	29560	S. L.	13	3:09	74	1360

*Reduce Weight 300 Lb. for Water

**Step 7 of Mission Plan is: Summary of Performance at Target

Figure A10-2

SAMPLE PROBLEM II: LO-LO-HI MISSION PLAN**Mission Rules:**

A combat mission is to be flown at long range cruise speeds, at tree top level to the target, returning at 35,000 feet, carrying drop tanks and two externally mounted M-117 750 pound bombs. Within 50 nautical miles of target a dash-in is to be performed at 0.9 Mach and the bombs released in a lay-down delivery. A minimum 1000 pound landing fuel reserve is required. The drop tanks are to be jettisoned when empty. Prepare a flight plan for a target 680 nautical miles from air base.

Weather Conditions:

An average 10°C colder than Standard Day with prevailing tailwinds of 20 knots.

Take-Off Configuration: [947] N/C/W

Clean + 650 gal tank (centerline) + (2) 450 gal tanks (inboard) + (2) M-117 750 lb bombs (outboard).

Weights: Figure A1-5

Clean aircraft with full B/B tanks (10,075 lb fuel)	38,200 LB
Centerline Tank	347 LB
Wing Tanks	658 LB
External fuel (650 gal + 900 gal = 4225 lb + 5850 lb)	10,075 LB
(2) M117 750 lb bombs (799 x 2)	1598 LB
(2) Universal Outboard Pylons (132 x 2)	264 LB
Water for take-off	300 LB
Take-off gross weight	51,442 LB

Computation:**Step 1. Take-Off**

Assume that 1500 lb of fuel, one minute and 300 lb of water are used for take-off and acceleration to cruise speed

Gross Weight After Take-Off
(51,442 - 1500 - 300) 49,642 LB

Time elapsed 1.0 MIN

Fuel Remaining (20,150 - 1500) . . . 18,650 LB

Step 2. Outboard Cruise (first leg)**A. From figure A1-5 determine the Initial Configuration Drag Index.**

(1) 650 gal tank (centerline). 24

(2) 450 gal tank (inboard) 28

(2) M-117 750 lb bombs (outboard)
in presence of inb'd tanks 32

Initial Configuration Drag Index . . . 84

Note

Configuration Drag Index changes whenever external tanks, bombs and/or pylons are jettisoned.

B. Use figure A4-2 for Cruise Performance.

1. Cruise with fuel remaining in centerline tank (4225 - 1500) 2725 LB

2. Compute Average Gross Weight:
49,642 - (2725 ÷ 2) 48,280 LB

3. Read Standard Day Temperature at Sea Level Pressure Altitude from Standard Atmosphere Table (figure A1-10) +15°C

4. Compute ambient Temperature (+15° - 10°) = +5°C

5. From figure A4-2 read

a. Cruise Distance
(including effect of tailwind) . . . 143 NMi

b. Mach number for cruise 0.6 M

c. Time to cruise 21.0 MIN

6. Final Gross Weight
(49,642 - 2725) 46,917 LB

7. Fuel Remaining
(18,650 - 2725) 15,925 LB

C. Jettison Centerline Tank

1. Final Gross Weight
(46,917 - 347) 46,570 LB

2. New Configuration Drag Index
(figure A1-5)

(2) 450 gal tanks (inboard) 28

(2) M-117 750 lb bombs (outboard)
in presence of inboard tanks 32

Configuration Drag Index = 60

Step 3. Outbound Cruise (second leg)

A. Cruise with Wing Tank Fuel

1. Fuel Used to cruise 5850 LB

2. Compute Average Gross Weight:
46,570 - (5850 ÷ 2) 43,645 LB

3. Ambient Temperature
(computed in Step 2-B-4) +5°C

4. From figure A4-2 read:

a. Cruise distance 336 NMi

b. Mach number for cruise 0.59 M

c. Time to cruise 50.0 MIN

5. Final Gross Weight
(46,570 - 5850) 40,720 LB

6. Fuel Remaining (15,925 - 5850) 10,075 LB

B. Jettison Wing Tanks

1. Final Gross Weight (40,720 - 658) 40,062 LB

2. New Configuration Drag Index
(figure A1-5)

(2) M-117 750 lb bombs (out-
board) not in presence of inboard
tanks 26

Step 4. Outboard Cruise (third leg)

A. Flight plan requires 680 nautical mile radius
of which 50 nautical miles (outbound) is dash
at 0.9 Mach. Thus far, 479 nautical miles have
been computed. The remaining outbound
cruise is therefore
(680 - 479 - 50) 151 NMi

1. Estimate fuel required 2000 LB

2. Estimate Average Gross Weight
40,062 - (2000 ÷ 2) 39,062 LB

3. Ambient Temperature
(computed in Step 2-B-4) +5°C

4. From figure A4-2 for a 151 NMi
cruise read: Fuel Used 2310 LB

B. Since the estimated fuel does not equal the com-
puted fuel

1. Re-estimate Average Gross Weight
40,062 - (2310 ÷ 2) 38,907 LB

2. Ambient Temperature +5°C

3. From figure A4-2 for a 151 NMi cruise read:

a. Fuel used 2310 LB

b. Mach number for cruise 0.58 M

c. Time to cruise 23.0 MIN

4. Final Gross Weight (40,062 -
2310) 37,752 LB

5. Fuel Remaining (10,075 - 2310) . 7765 LB

Step 5. Dash at Sea Level at 0.9 Mach number for 50 Nautical Miles

A. Since figure A4-4 is entered at average gross
weight, estimate the fuel used for 50 nautical
mile run-in.

1. Estimate dash fuel 1500 LB

2. Estimate Average Gross Weight
37,752 - (1500 ÷ 2) 37,002 LB

3. Ambient Temperature
(see Step 2-B-4) +5° C
4. From figure A4-4 read True
Airspeed at 0.9 Mach number
at 5° C 585 Knots
5. From figure A4-4 read:
Fuel Flow 13,400 LB/HR
6. Compute ground speed = True
Airspeed + Tailwind (585 + 20). 605 Knots
7. Compute time required to dash
50 NMi: Distance ÷ Ground Speed =
(50 ÷ 605) = 0.083 HR
8. Compute fuel required = fuel flow x
time (13,400 x 0.083) 1110 LB

B. Since the estimated fuel does not equal the computed fuel

1. Re-estimate Average Gross Weight:
37,752 - (1110 ÷ 2) 37,197 LB
2. Ambient Temperature +5° C
3. From figure A4-4 True Airspeed 585 Knots
4. From figure A4-4 fuel flow ... 13,400 LB/HR

5. Since True Airspeed and Fuel Flow have not changed, Steps 5A6 thru 8 do not have to be redone.

6. Time required for dash 0.083 hr. x
60 $\frac{\text{min}}{\text{hr}}$ 5.0 MIN

7. Final Gross Weight (37,752 - 1110) 36,642 LB

8. Fuel Remaining (7765 - 1110) 6655 LB

Step 6. Deliver Bombs

A. Assume 280 lb of fuel and one minute of time for a lay-down delivery.

1. Final Gross Weight
(36,642 - 280 - 1862*) ... 34,500 LB
2. Time Elapsed 1 MIN
3. Fuel Remaining (6655 - 280) 6375

*Weight of bombs and pylons.

B. New Configuration Drag Index from figure A1-5 for clean aircraft = 0.

Step 7. Summary of Performance at Target

1. Aircraft Gross Weight 34,500 LB
2. Fuel Remaining 6375 LB
3. Distance Covered 680 NMi
4. Time Elapsed 1 HR 41 MIN
5. Configuration Drag Index ... 0

Note

For return, assume no change in weather conditions; therefore, the 20 knot wind is now a headwind.

Step 8. Military Thrust Climb to 35,000 feet

A. From figure A3-3

1. Fuel Used 790 LB
2. Distance Covered 41 NMi
3. Time Elapsed 4.7 MIN

Note

Climb charts include effect of average Ambient Temperature. Effect of wind can be considered negligible.

B. 1. Final Gross Weight (34,500 - 790) 33,710 LB

2. Fuel Remaining (6375 - 790) .. 5585 LB

Step 9. Return Cruise

A. Determine Return Cruise Distance. Since return distance must equal 680 nautical miles including climb, cruise and descent, estimate a descent distance

1. Estimate a weight at start of descent as:

(Weight at end of climb + Empty Weight)
÷ 2 (33,710 + 28,125) ÷ 2 = 30,918 LB

2. From figure A7-1,
distance to descend 74 NMi

3. Cruise distance required
 $(680 - 41 - 74)$ 565 NMi

B. For a cruise of 565 NMi at 35,000 feet

1. Estimate fuel required 3000 LB
2. Estimate Average Gross Weight
 $33,710 - (3000 \div 2)$ 32,210 LB
3. Read Standard Day Temperature at 35,000
 feet pressure altitude from Standard Atmos-
 phere Table (figure A1-10) -54.34°C
4. Compute Ambient Temperature
 $(-54 - 10^{\circ})$ -64°C
5. From figure A4-2 read fuel used to
 cruise 565 miles 3950 LB

C. Since the estimated fuel does not equal the
 computed fuel

1. Re-estimate average gross weight:
 $33,710 - (3951 \div 2)$ 31,735 LB
2. Ambient Temperature
 (same as 9-B-4) -64°C
3. From figure A4-2 for a 565 NMi
 cruise read:
 - a. Fuel used 3900 LB

b. Mach number for cruise 0.893 M

c. Time to cruise 70 MIN

4. Final Gross Weight $(33,710 - 3900)$ 29,810 LB

5. Fuel Remaining $(5585 - 3900)$... 1685 LB

Step 10. Maximum Range Descent

A. From figure A7-1

1. Distance to descend 74 NMi
 (Since distance to descend (74 NMi)
 is the same as estimated in Step 9A.
 Mission can be continued)

2. Fuel used in descent 250 LB

3. Time elapsed in descent 13 MIN

4. Final Gross Weight $(29,810 - 250)$.. 29,560 LB

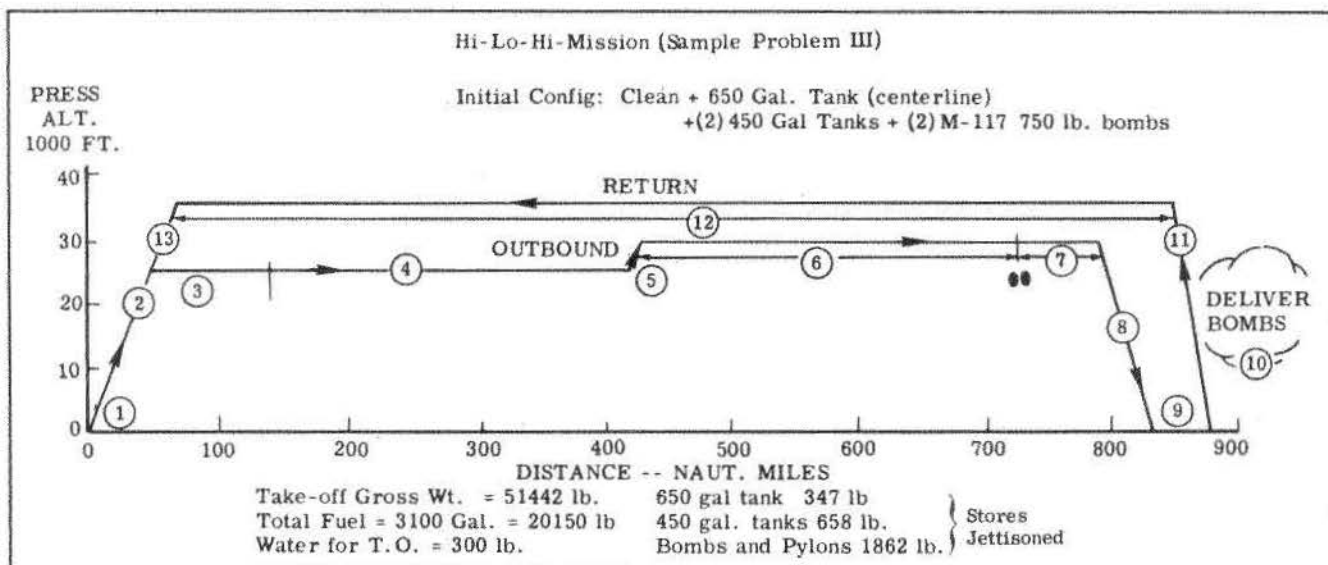
5. Fuel Remaining $(1685 - 250)$ 1435 LB

Summary: Total Mission Performance

1. Radius of Action ... 680 NMi

2. Total Mission Time 3 HRS 9 MIN

3. Fuel Remaining (or Reserve) 1435 LB



Step	Operation	Config. Drag Index	Leg Fuel Used	Sum Fuel Used	Fuel Remaining	Final Gross Weight	Alt. at End of Step	Leg. Time	Sum Time	Leg Dist.	Sum Dist.
			LB.	LB.	LB.	LB.	FT.	MIN.	HR: MIN.	N. MI.	N. MI.
	Initial Configuration			0	20150	51442			0		
1	Taxi, Take-off and Accelerate to Climb Speed*		1500	1500	18650	49642	S. L.	1	0:01	-	0
2	Military Thrust Climb to 25000 Ft.	84	1650	3150	17000	47992	25000	9	0:10	63	63
3	Cruise at 25000 Ft. Jettison 650 Gal Tank	84	1075	4225	15925	46917 46570	25000	10	0:20	88	151
4	Cruise at 25000 Ft.	60	2925	7150	13000	43645	25000	31	0:51	265	416
5	Military Thrust Climb to 30000 Ft.	60	190	7340	12810	43455	30000	2	0:53	14	430
6	Cruise at 30000 Ft. Jettison Wing Tanks	60	2735	10075	10075	40720 40062	30000	32	1:25	275	705
7	Cruise at 30000 Ft.	26	720	10795	9355	39342	30000	10	1:35	85	790
8	Combat Descent to S. L.	26	110	10905	9245	39232	S. L.	5	1:40	43	833
9	Dash at S. L. at 0.9 Mach	26	1110	12015	8135	38122	S. L.	5	1:45	50	883
10	Lay Down Delivery of Bombs	26	280	12295	7855	35980	S. L.	1	1:46	-	
11	Military Thrust Climb to 35000 Ft.	0	820	13115	7035	35160	35000	5	1:51	44	927
12	Cruise at 35000 Ft.	0	5350	18465	1685	29810	35000	94	3:25	765	1692
13	Maximum Range Descent to S. L.	0	250	18715	1435	29560	S. L.	13	3:38	74	1766

*Reduce Weight 300 Lb. for Water

Figure A10-3

SAMPLE PROBLEM III: HI-LO-HI MISSION PLAN

Note

- A. Estimate Radius of Action based on Sample Problem II. Sample Problem II was calculated as a Lo-Lo-Hi Mission requiring 680 NMi radius of action. To determine the increase in radius of action if the outbound cruise was accomplished at high constant altitude proceed as follows:

Step 1. Use: Rule of Thumb Number II
1.5 to 2 NMi range (high altitude)
equals one NMi range (low altitude).

Step 2.

- a. Outbound Cruise
 $680 - 50 = 630$ cruise at S.L.
 $630 \times 1.75 = 1130$ cruise at high altitude
- b. 1103 cruise + 50 dash = 1153 NMi out-bound range
- c. Return range (from Sample Problem II) = 680 NMi
- d. Total Range: $1153 + 680 = 1833$ NMi
- e. Estimated Radius = $1833 \div 2 = 916$ NMi

Note

The 916 NMi Radius of Action is an Estimated Capability. A detailed flight plan must be computed to determine the exact radius capability as follows:

- B. Check Radius of Action Estimate

Step 1. Take-off: Same as Sample Problem II

Final Gross Weight	49,642 LB
Fuel Remaining	18,650 LB
Configuration Drag Index	84

Step 2. Military Climb to Altitude

- A. From figure A3-7 read Optimum
Cruise Altitude 26,000 FT

Since there is no significant difference in constant altitude cruise between 25,000 and 26,000 FT, use 25,000 feet as initial cruise altitude.

- B. From figure A3-4 read fuel and distance to climb from S.L. to 25,000 feet

1. Fuel used	1650 LB
2. Distance covered	63 NMi
3. Time elapsed	9.0 MIN
4. Final gross weight ($49,642 - 1650$)	47,992 LB
5. Fuel remaining ($18,650 - 1650$)	17,000 LB

Step 3. Outbound Cruise (First leg)

- A. Use figure A4-2 for Cruise Performance

1. Cruise with fuel remaining in centerline tank ($4225 - 1500 - 1650$) 1075 LB
2. Compute Average Gross Weight
 $47,992 - (1075 \div 2) = 47,454$ LB
3. Read Standard Day temperature at 25,000 FT pressure altitude from Standard Atmosphere Table (figure A1-10) -34.53°C
4. Compute Ambient Temperature
 $(-34.53^{\circ} - 10^{\circ}) = -44.53^{\circ}\text{C}$
5. From figure A4-2 read

a. Cruise distance	88 NMi
b. Mach number for cruise	0.846 M
c. Time to cruise	10.0 MIN

6. Final Gross Weight
 $(47,992 - 1075) = 46,917$ LB
7. Fuel Remaining ($17,000 - 1075$) 15,925 LB

- B. Jettison Centerline Tank

1. Final Gross Weight ($46,917 - 347$) 46,570 LB

2. New Configuration Drag Index figure A1-5

(2) 450 gal tanks inboard	28
(2) M-117 750 lb bombs (outb'd) in presence of inboard tanks	<u>32</u>
Configuration Drag Index =	60

Step 4. Outbound Cruise (Second leg)

- A. From figure A3-7 read optimum cruise altitude 28,700 FT

Note

Since optimum altitude is below 30,000 ft, continue cruising at 25,000 ft.

- B. Use figure A4-2 for Cruise Performance

1. First Fuel increment
(1/2 wing tank fuel) 2925 LB
 2. Compute Average Gross Weight
 $46,570 - (2925 \div 2)$ 45,107 LB
 3. Ambient Temperature
(See step 3A4) -44.5°C
 4. From figure A4-2 read
 - a. Cruise distance 265 NMi
 - b. Mach number for cruise 0.85 M
 - c. Time to cruise 30.5 MIN
 5. Final Gross Weight
 $(46,570 - 2925)$ 43,645 LB
 6. Fuel remaining
 $(15,925 - 2925)$ 13,000 LB
- C. From figure A3-7 read optimum cruise altitude 30,000 FT

Note

Since optimum cruise altitude is 30,000 ft, climb to 30,000 ft before next cruise leg.

Step 5. Military Climb from 25,000 to 30,000 feet

- A. From figure A3-3 read

1. Fuel used in climb $(1370 - 1180)$ 190 LB
2. Distance covered in climb $(63 - 49)$ 14 NMi
3. Time elapsed $(7.6 - 5.6)$ 2.0 MIN

- B. 1. Final Gross Weight

$(43,645 - 190)$ 43,455 LB

2. Fuel Remaining

$(1300 - 190)$ 12,810 LB

Step 6. Outbound Cruise (Second leg)

- A. Cruise out with remainder of wing tank fuel

1. Cruise fuel
 $(5850 - 2925 - 190)$ 2735 LB
2. Average Gross Weight
 $43,455 - (2735 \div 2)$ 42,088 LB
3. From figure A1-10 read standard day temperature at 30,000 ft -44.4°C
4. Compute ambient temperature at 30,000 $(-44.4^{\circ} - 10^{\circ})$ -54.4°C
5. From figure A4-2 read
 - a. Cruise distance 275 NMi
 - b. Mach number for cruise 0.870 M
 - c. Time to cruise 31.5 MIN
6. Final gross weight
 $(43,455 - 2735)$ 40,720 LB
7. Fuel remaining
 $(12,810 - 2735)$ 10,075 LB

- B. Jettison Wing Tanks

1. Final Gross Weight
 $(40,720 - 658)$ 40,062 LB
2. New Configuration Drag Index (figure A1-5)
(2) M-117 750 lb bombs (outb'd) not in presence of inb'd tanks 26

Step 7. Outbound Cruise (third leg)

- A. From figure A3-7 read optimum
cruise altitude 33,000 FT

Note

Since Optimum Cruise Altitude is below
35,000 ft, continue cruising at 30,000 ft

- B. Determine remainder of cruise distance

Since Estimated Radius of Action is 916
Nmi, of which 705 Nmi (63 + 88 + 265
+ 14 + 275) has already been computed,
approximately 211 Nmi remain to reach
the target. This 211 Nmi will consist of
cruise, descent and 50 Nmi of dash.
Since the radius is only approximate,
the exact length of this leg is not
significant, but would be
approximately 100 Nmi

- C. For a cruise of 100 Nmi at 30,000 ft

1. Estimate fuel required 1000 LB
2. Estimate Average Gross Weight
40,062 - (1000 ÷ 2) 39,562 LB
3. Ambient Temperature
(See step 6A4) -54.4°C
4. From figure A4-2 read
 - a. Cruise distance 118 Nmi
 - b. Mach number for cruise 0.878 M
 - c. Time to cruise 13.5 MIN
5. Final Gross Weight
40,062 - 1000) 39,062 LB
6. Fuel remaining (10.075 - 1000) .. 9075 LB

Step 8. Combat Descent to Sea Level

(0.9 Mach or 400 KCAS whichever is
less) from figure A7-2.

1. Distance to descend 43 Nmi
2. Fuel used in descent 110 LB
3. Time elapsed in descent 5.4 MIN

4. Final gross weight
(39,062 - 110) 38,952 LB

5. Fuel remaining (9075 - 110) ... 8965 LB

Step 9. Dash at Sea Level at 0.9 Mach number for
50 nautical miles.

- A. Since a small difference in average gross weight
will not significantly change the fuel flow at
0.9 Mach at Sea Level, use data computed in
Step 5 of Sample Problem II.

1. Fuel used 1110 LB
2. Time required for dash 5.0 MIN
3. Final gross weight
(38,952 - 1110) 37,842 LB
4. Fuel remaining (8965 - 1110) ... 7855 LB

Step 10. Deliver Bombs

- A. Same as step 6 of Sample II

1. Fuel used 280 LB
2. Time elapsed 1.0 MIN
3. Final gross weight
(37,842 - 280 - 1862*) 35,700 LB
4. Fuel remaining (7855 - 280) ... 7575 LB

*Weight of bombs and pylons

- B. Summary of Performance at Target

1. Aircraft Gross Weight 35,700 LB
2. Fuel remaining 7575 LB
3. Distance Covered 916 Nmi
4. Time Elapsed 1 HR 49 MIN
5. Configuration Drag Index
(figure A1-5) 0

Note

For return, assume no change in weather
conditions; therefore, the 20 knot wind
is now a headwind.

Step 11. Military Thrust Climb to 35,000 feet

A. From figure A3-3

1. Fuel used 820 LB
2. Distance covered 44 NMi
3. Time elapsed 4.8 MIN

Note

Climb Charts include effect of average ambient temperature. Effect of wind can be considered negligible.

- B. 1. Final gross weight
(35,700 - 820) 34,880 LB
2. Fuel remaining (7575 - 820) 6755 LB

Step 12. Return Cruise

- A.1. Allowing the same amount of fuel for descent and landing reserve as in Sample Problem II, fuel available for final cruise leg is (6755 - 250 - 1435) 5070 LB
2. Compute Average Gross Weight
 $34,880 - (5070 \div 2)$ 32,345 LB
3. From figure A1-10, read Standard Day Temperature at 35,000 ft -54.34°C
4. Compute Ambient Temperature
(-54 - 10) -64°C
5. From figure A4-2 read cruise distance 725 NMi
6. Time to cruise 89.0 MIN
7. Final gross weight
 $34,880 - 5070$ 29,810 LB
8. Fuel remaining
(6755 - 5070) 1685 LB

Step 13. Maximum Range Descent to Sea Level

A. From figure A7-1

1. Distance to descend 74 NMi

2. Fuel used to descend 250 LB
3. Time elapsed 13.0 MIN
4. Final gross weight
(29,810 - 250) 29,560 LB
5. Fuel remaining (1685 - 250) ... 1435 LB

- B. Total return distance
(44 + 725 + 74) 843 NMi

Step 14. Balance Mission

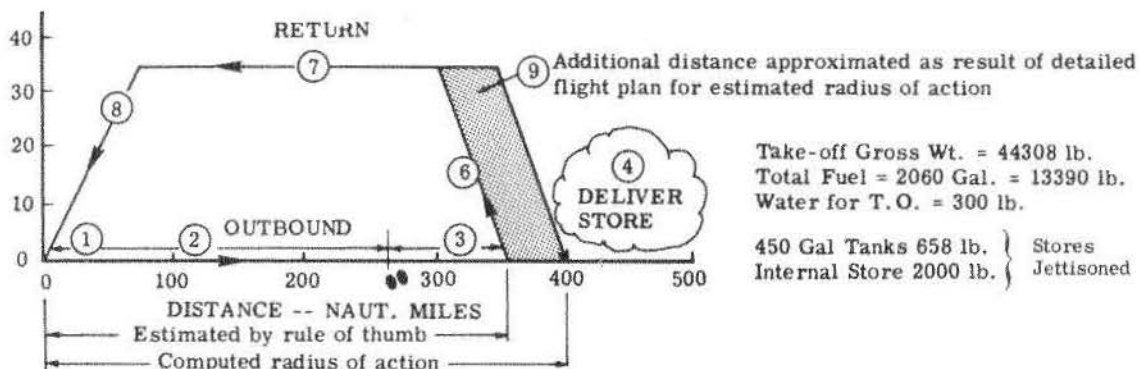
- A.1. Since outbound range is 916 NMi and return is 843, mission is out of balance by (916 - 843) 73 NMi
2. Compute NMi/LB for last outbound leg (118 NMi $\div$ 1000 lb of fuel) 0.118 NMi/LB
3. Compute NMi/LB for return cruise leg (725 NMi $\div$ 5070 LB of fuel) 0.143 NMi/LB
4. Fuel to be transferred from outbound to return leg = incremental range $\div$ (outbound NMi/LB + return NMi/LB) or
 $73 \div (0.118 + 0.143) =$
 $73 \div 0.261 =$ 280 LB
- B. Change Outbound Cruise by
 1. $-280 \times 0.118 =$ -33 NMi
 2. Revised outbound range
(916 - 33) 883 NMi
- C. Change Return Cruise by
 1. $+280 \times 0.143 =$ +40 NMi
 2. Revised return range
(843 + 40) 883 NMi
- D. Revised Estimated Radius of Action = 883 NMi

Step 15. If a precise mission plan is required, repeat steps 7 through 12, adjusting cruise fuel as indicated in step 14. The resulting mission plan is shown as figure A10-3.

Lo-Hi Mission (Sample Problem IV)

PRESS
ALT
1000 FT.

Initial Config: Clean + (2) 450 gal. tanks + internal store



Step	Operation	Config. Drag Index	Leg Fuel Used	Sum Fuel Used	Fuel Remaining	Final Gross Weight	Alt. at End of Step	Leg Time	Sum Time	Leg Dist.	Sum Dist.
			LB.	LB.	LB.	LB.	FT.	MIN.	HR : MIN.	N. MI.	N. MI.
	Initial Configuration				13390	44308			0		0
1	Taxi, Take-off and Accelerate to Climb Speed*		1500	1500	11890	42508	S. L.	1	0:01	-	0
2	Cruise at Sea Level (Use Wing Tank Fuel) Jettison Wing Tanks	28	4350	5850	7540	38158	S. L.	41	0:42	265	265
3	Cruise at Sea Level	0	1500	7350	6040	36000	S. L.	16	0:58	100	365
4	Lay Down Delivery of Store	0	280	7630	5760	33720	S. L.	1	0:59	-	
5**											
6	Military Thrust Climb to 35000 Ft.	0	820	8450	4940	32900	35000	5	1:04	46	411
7	Cruise at 35000 Ft.	0	1630	10080	3310	31270	35000	28	1:32	245	656
8	Maximum Range Descent to S. L.	0	245	10325	3065	31025	S. L.	13	1:45	74	730
9	Compute: Additional Distance Capability to have 2000 Lb. of Fuel Remaining		1065 Lb { 737 x 0.067 = 49 N. Mi. 328 x 0.150 = 49 N. Mi. } See Detailed Sample IV								

*Reduce Weight 300 Lb. for Water

**Step 5 of Mission Plan is: Summary of Performance at Target

Figure A10-4

SAMPLE PROBLEM IV: LO-HI MISSION PLAN

A combat radius to be flown at long range cruise speeds, at tree-top level to the target, returning at 35,000 feet, carrying drop tanks and an internal store. Drop tanks are to be jettisoned when empty and the store released in a lay-down delivery. Prepare a flight plan to determine the maximum radius capability under these rules, retaining a 2000 pound landing fuel reserve.

Weather Conditions:

Standard Day, no wind.

Take-Off Configuration: [947] N/C/W

Clean + (2) 450 gal tanks + internal store

Weights: Figure A1-5

Clean Aircraft without B/B tank (7540 lb of fuel)	35,500 LB
(2) 450 gal tanks	658 LB
External Fuel (900 gal tanks)	5850 LB
Internal Store	2000 LB
Water for Take-Off	300 LB
Take-Off Gross Weight	44,308 LB
Total Fuel on board	13,390 LB

Note

To determine a radius of action for a set of given conditions proceed according to the following general outline:

“A” Estimate radius of action by using “Rules of Thumb”

“B” Compute a detailed flight plan for the estimated radius.

“C” Adjust “B” to obtain maximum radius of action.

“A” Estimate Radius of Action from Rules of Thumb I Lo-Hi Mission

Normal Internal Fuel 155 NMi

Wing Tanks 210 NMi

Estimated R/A 365 NMi

“B” Prepare Flight Plan for Estimated Radius

Step 1. Take-Off

Assume that 1500 pounds of fuel, one minute and 300 pounds of water are used for take-off and acceleration to cruise speed:

Gross Weight After Take-Off
(44,308 - 1500 - 300) 42,508 LB

Time Elapsed 1 MIN

Fuel Remaining (13,390 - 1500) 11,890 LB

Step 2. Outbound Cruise - (first leg)

A. From figure A1-5 determine the initial configuration drag index

(2) 450 gal tanks 28

Note

Configuration Drag Index changes whenever external tanks, bombs and/or pylons are jettisoned.

B. Use figure A4-2 for Cruise Performance at Sea Level

1. Cruise with fuel remaining in wing tanks (5850 - 1500) 4350 LB

2. Compute Average Gross Weight
42,508 - (4350 ÷ 2) 40,333 LB

3. From figure A1-10 Standard Day Temperature at Sea Level pressure altitude +15°C

4. From figure A4-2

Mach number for cruise 0.587 M

Time to cruise 41.0 MIN

Cruise distance 265 NMi

5. Final Gross Weight
(42,508 - 4350) 38,158 LB

6. Fuel Remaining (11,890 - 4350) . . . 7540 LB

C. Jettison Wing Tanks

1. Final Gross Weight
(38158 - 658) 37,500 LB

2. New Configuration Drag Index
(from figure A1-5)
for the Clean Aircraft 0

Step 3. Outbound Cruise (Second Leg)

A. Flight Plan requires an estimated 365 nautical mile radius. Thus far 265 NMi have been computed. The remaining outbound cruise is therefore (365 - 265) 100 NMi

1. Estimate fuel used 2000 LB

2. Estimate average gross weight
 $37,500 - (2000 \div 2)$ 36,500 LB

3. Ambient Temperature
(See step 2-B-3) +15°C

4. From figure A4-2 read fuel used
for 100 NMi 1500 LB

B. Since the estimated fuel does not equal the computed fuel

1. Re-estimate Average Gross Weight
 $37,500 - (1500 \div 2)$ 36,750 LB

2. Ambient Temperature
(Same as step 3A-3) +15°C

3. From figure A4-2 for a 100 NMi
cruise read

a. Fuel used 1500 LB

b. Mach number for cruise 0.583 M

c. Time to cruise 15.5 MIN

4. Final Gross Weight
(37,500 - 1500) 36,000 LB

5. Fuel Remaining (7540 - 1500) . . . 6040 LB

Step 4. Deliver Store

Assume 280 lb of fuel and 1 min of time for a lay-down delivery.

1. Final Gross Weight
(36,000 - 280 - 2000*) 33,720 LB

2. Fuel Remaining (6040 - 280) 5760 LB

3. Time Elapsed 1 MIN

*Weight of Store

Step 5. Summary at Target

1. Fuel Remaining 5760 LB

2. Distance Covered 365 NMi

3. Time Elapsed 59 MIN

4. Aircraft Gross Weight 33,720 LB

5. Configuration Drag Index 0

Step 6. Military Thrust Climb to Cruise Altitude

A. From figure A3-3

1. Fuel Used 820 LB

2. Distance Covered 46 NMi

3. Time Elapsed 5.0 MIN

4. Final Gross Weight
(33,720 - 820) 32,900 LB

5. Fuel Remaining (5760 - 820) 4940 LB

Step 7. Return Cruise

A. Determine return cruise distance. Since return distance must equal 365 NMi including climb, cruise and descent, estimate the descent distance.

1. Estimate weight at start of descent as:
(Weight at end of climb + Empty Weight + Fuel Reserve) $\div$ 2 (32,900 + 27,960 + 2000 $\div$ 2) 31,430 LB

2. From figure A7-1 read distance to descend from 35,000 ft 74 NMi

3. Compute Cruise Distance required
(365 - 46 - 74) 245 NMi

B. Estimate fuel used to cruise 245 NMi.

1. Estimate fuel used 2000 LB

2. Estimate Average Gross Weight
 $32,900 - (2000 \div 2) \dots\dots\dots 31,900 \text{ LB}$

3. From figure A1-10 Standard Day
 Temperature at 35,000 ft
 pressure altitude $\dots\dots\dots -54.3^\circ\text{C}$

4. From figure A4-2 read fuel used
 to cruise 245 NMi $\dots\dots\dots 1630 \text{ LB}$

C. Since estimated fuel does not equal computed fuel

1. Re-estimate Average Gross Weight
 $32,900 - (1630 \div 2) \dots\dots\dots 32,085 \text{ LB}$

2. Ambient Temperature
 (Same as step 7-B-3) $\dots\dots\dots -54.3^\circ\text{C}$

3. From figure A4-2 read

- a. Fuel used $\dots\dots\dots 1630 \text{ LB}$
- b. Mach number for cruise $\dots\dots\dots 0.895 \text{ M}$
- c. Time to cruise $\dots\dots\dots 28.5 \text{ MIN}$

4. Final Gross Weight
 $(32,900 - 1630) \dots\dots\dots 31,270 \text{ LB}$

5. Fuel Remaining $(4940 - 1630) \dots\dots 3310 \text{ LB}$

Step 8. Maximum Range Descent

A. From figure A7-1 read

1. Distance to descend $\dots\dots\dots 74 \text{ NMi}$

Note

Descent distance was estimated in step 7A. Since the estimated distance equals the distance read in step 8, the mission can be continued.

2. Fuel used to descend $\dots\dots\dots 245 \text{ LB}$

3. Time to descend $\dots\dots\dots 12.8 \text{ MIN}$

4. Final Gross Weight $(31,270 - 245) \dots\dots 31,025 \text{ LB}$

5. Fuel Remaining $(3310 - 245) \dots\dots 3065 \text{ LB}$

Note

Initial Mission Rules stated that reserve fuel should equal 2000 lb. The above flight plan accomplishes the estimated radius of 365 NMi with a fuel reserve of 3065 lb. Therefore, adjust radius capability for the additional 1065 lb of usable fuel.

Step 9. Correct estimated Radius of Action as follows:

A. To distribute the additional 1065 lb of fuel

1. Compute return cruise NMi/LB:
 $(\text{dist} \div \text{fuel}) = 245 \div 1630$
 (from step 7) = $\dots\dots\dots 0.150 \text{ NMi/LB}$

2. Compute outbound cruise NMi/LB
 (for last leg): $(\text{dist} \div \text{fuel}) = 100 \div 1500$
 (from step 3) $\dots\dots\dots 0.067 \text{ NMi/LB}$

3. Compute additional distance if all additional fuel were used for return
 (fuel x NMi/LB)
 $1065 \times 0.150 = \dots\dots\dots 160 \text{ NMi}$

4. Compute the additional outbound fuel needed to balance radius
 Incremental range $\div$ (outbound NMi/LB + return NMi/LB or $160 \div (0.067 + 0.150) = 160 \div 0.217 \dots\dots\dots 737 \text{ LB}$

5. The additional 1065 lb of fuel therefore, should be distributed as:
 $737 \text{ lb (outbound cruise)} \times 0.067 = \dots\dots\dots 49 \text{ NMi}$
 $0.150 (1065 - 737) = \dots\dots\dots 49 \text{ NMi}$

6. Therefore, the maximum radius of action is $365 + 49 = \dots\dots\dots 414 \text{ NMi}$

Note

If a detailed flight plan is required, return to step 3 and adjust cruise fuel as indicated above, and compute the mission from that point.

Appendix II

PERFORMANCE DATA



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INTRODUCTION

Appendix II is divided into parts (1 through 10) to present performance data in proper sequence for pre-flight planning. The requirements for carriage of a large number of different kinds of external stores on the F-105 aircraft have made the presentation of performance data for specific configurations in the Flight Manual impractical. Accordingly the charts presented in this Appendix may be used to deter-

mine the performance for the aircraft in any configuration of required external stores. Data on each chart is presented for drag indices ranging from a drag index of 0 for the clean aircraft [947] N/C/W with no external stores to a drag index of 200. Each external store, for which a requirement has been established for the aircraft, has been assigned a drag number. The configuration drag index for a given configuration is the sum of the store drag numbers.

ABBREVIATIONS

A/B	Afterburner	Max	Maximum
Alt	Altitude	MER	Multiple Ejector Rack
AMI	Airspeed Mach Indicator	Min	Minute(s)
AVVI	Altitude — Vertical Velocity Indicator	MPH	Miles per hour
B/B	Bomb Bay	Naut Mi	Nautical Mile(s)
°C	Degrees Centigrade	N/C/W	Technical Order not Complied with
CAS	Calibrated Airspeed	N Mi	Nautical Mile(s)
Config	Configuration	No.	Number
Cont	Continuous	O.A.T.	Outside Air Temperature
CR-CL	Cruise Climb	Outb'd	Outboard
CU ft	Cubic feet	PSI	Pounds per Square Inch
C/W	Technical Order complied with	R/A	Radius of Action
Dist	Distance	ROR	Runway Condition Reading
°F	Degrees Fahrenheit	RPM	Revolutions per minute
FPM	Feet per minute	Sec	Second(s)
Ft	Feet	SL	Sea Level
Gal	Gallon(s)	Sq ft	Square feet
Hr	Hour(s)	Std	Standard
IAS	Indicated Airspeed	TAS	True Airspeed
ICAO	International Civil Aviation Organization	TE	Trailing Edge
IFIS	Integrated Flight Instruments System	Temp	Temperature
In Hg	Inches of Mercury	T.O.	Takeoff
Inb'd	Inboard	Wt	Weight
KCAS	Knots Calibrated Airspeed	ΔM	Mach number increment
KIAS	Knots Indicated Airspeed	ΔH	Altitude increment
KTAS	Knots True Airspeed	ΔV	Airspeed increment
Lb	Pound(s)	δ	Delta: ratio of ambient air pressure to standard sea level air pressure
LE	Leading Edge	σ	Sigma: ratio of ambient air density to standard sea level air density
M	Mach number		

DEFINITION OF TERMS

Acceleration Check Distance: distance to the runway marker which is 2000 feet short of the go, no — go distance.

Acceleration Check Speed: minimum speed at the acceleration check marker.

Afterburner: aft section of the engine in which fuel is burned to augment the engine thrust.

Airspeed: the speed of the aircraft relative to the air through which it is moving.

Ambient Conditions: conditions of the air surrounding the aircraft at any given time under consideration.

Calibrated Airspeed: indicated airspeed corrected for position error; or indicated tape airspeed corrected for cam error.

Centerline MER Pylon: a pylon designed to carry a multiple ejector rack at the centerline pylon station.

Climbout Index: an index based on takeoff thrust setting and ambient conditions, used to determine climbout performance after takeoff.

Combat Ceiling: highest pressure altitude at which the aircraft can climb at the rate of 500 FPM.

Compressibility Error: an error in the airspeed indicator reading and the outside air temperature indicator reading caused by air being compressed by the moving aircraft.

Configuration Drag Index: the sum of the clean aircraft configuration drag index, the store drag numbers of external stores carried and the incremental drag number for lateral trim if the external stores are asymmetrical in weight, used to define the inflight performance of the aircraft so configured.

Cruise Ceiling: highest pressure altitude at which the aircraft can climb at the rate of 300 FPM with maximum continuous thrust.

Cruise Climb: the method of achieving maximum long range cruise performance by continually increasing cruise altitude as gross weight decreases.

Cruise Climb Altitude: the pressure altitude for a given configuration at a given gross weight at which maximum long range cruise is achieved.

Cruise Factor: a factor based on aircraft gross weight, configuration, cruise pressure altitude and cruise speed, used to determine cruise performance.

Density Altitude: the altitude obtained from a standard density altitude chart for any combination of pressure altitude and temperature, or for any density ratio factor ($1/\sqrt{\sigma}$).

Direct Loaded Pylon: pylon designed to carry a single weapon without racks, adapters, etc.

Diversion Summary: a chart showing distance (Diversion Range Summary) or time (Diversion Endurance Summary) available for various flight plans with small amounts of fuel on board at various pressure altitudes.

Equivalent Airspeed: calibrated airspeed corrected for compressibility.

Equivalent Gross Weight: aircraft gross weight times the load factor required to maintain a given bank angle.

Entry Gross Weight: a gross weight scale which relates maximum thrust acceleration performance to initial acceleration gross weight.

Go, No—Go Distance: distance traveled in reaching the last runway marker short of the refusal distance.

Go, No—Go Speed: minimum speed at the go, no—go marker.

Go, No—Go Tolerance: maximum speed deficiency that is acceptable at the go, no—go point to ensure a safe takeoff in 90% of the available runway.

Ground Speed: the speed of the aircraft relative to the ground over which it is flying. Under zero wind conditions, ground speed equals true airspeed.

Inches Hg: a measure of air pressure which compares it to the weight of a column of mercury.

Indicated Airspeed: standby airspeed indicator reading corrected for mechanical instrument error but uncorrected for position error.

Indicated Tape Airspeed: AMI airspeed reading uncorrected for cam error.

Long Range Cruise Speed: the higher speed for 99% maximum range at which it is recommended to fly the aircraft when range is of more concern than time.

Maximum Continuous Thrust: the highest thrust setting allowable for continuous operation.

Maximum Thrust: military thrust augmented by afterburning; limited to 15 minutes continuous operation inflight and 20 seconds on the ground.

Military Thrust: maximum non-augmented thrust; limited to 30 minutes continuous operation in flight and 5 minutes on the ground.

Minimum Afterburner Blow-out Speed: the lowest speed to which the aircraft can accelerate with maximum thrust, experience an afterburner failure, and then complete the takeoff with military thrust without exceeding the available runway length.

Multiple Weapon Pylon: a cast magnesium pylon, trailing edge swept aft from wing to store, designed to carry a single nuclear weapon, a single conventional weapon or a multiple ejector rack at the centerline or inboard pylon stations.

Nautical Miles per Pound: the number of air nautical miles traveled while consuming a pound of fuel.

Position Error: the error in the airspeed indicator reading and the altimeter reading caused by the inability of the static orifices to experience the true ambient air pressure.

Pressure Altitude: the altitude obtained from a standard atmosphere table for any given value of air pressure. This is the altitude that an altimeter will show (after correcting for position error) when the barometric pressure at sea level is 29.92 inches Hg.

Receiver Factor: a factor based on receiver gross weight, configuration, refueling altitude and refuel speed, used to obtain refueling factor.

Refueling Factor: the sum of receiver and tanker factors, used to determine receiver fuel consumption during inflight refueling.

Refusal Distance: the distance required to accelerate to the refusal speed.

Refusal Speed: maximum speed to which the aircraft can accelerate and then stop in the available runway length.

Rotation Speed: airspeed at which the nose wheel leaves the runway.

Runway Condition Reading: the number portion of a system of reporting surface conditions at terminal airfields, related to the effectiveness of braking on the runway.

Specific Range: nautical miles per pound of fuel.

Standard Atmospheric Conditions: an arbitrarily selected set of atmospheric conditions chosen to approximate the average atmosphere of the world.

Standard Day: a day on which standard atmospheric conditions are assumed to exist.

Store Drag Number: a number related to the incremental drag of an externally mounted item, used to determine the configuration drag index.

Takeoff Index: an index based on takeoff thrust setting and ambient conditions, used to determine takeoff performance.

Takeoff Speed: airspeed at which the main wheels leave the runway.

Tanker Factor: a factor based on tanker gross weight, refueling altitude and refuel speed, used to determine refueling factor.

Touchdown Speed: airspeed at which the main wheels come in contact with the runway

True Airspeed: equivalent airspeed corrected for air density.

Universal Pylon: a built up pylon, trailing edge swept forward from wing to store, designed to carry a single conventional store at the inboard or outboard pylon station, or a multiple ejector rack at the inboard station.

Wind Component (Headwind or Tailwind): that part of the existing wind condition which acts opposite to or in the direction of travel.

CORRECTION CHARTS FOR ALTIMETER AND AIRSPEED INDICATORS

Correction charts for airspeed and altitude (figures B1-1 and B1-2) are provided to determine the values from those indicated on the standby instruments. These curves present the nose boom position error at five altitudes.

STANDBY ALTIMETER POSITION ERROR CORRECTION

Static pressure which determines the altimeter reading is not always accurately measured because of the location of the static port (position error). The altimeter position error chart (figure B1-1) is provided so that corrected pressure altitude can be calculated from the indicator reading.

To determine what indicated altitude to fly so that you will be at your assigned pressure altitude use the following equation:

$$\text{Indicated altitude} = (\text{pressure altitude}) - (\text{Altitude position Error correction})$$

Sample Problem

Given:

- Assigned pressure altitude — 20,000 feet
- Indicated airspeed (IAS) — 400 Knots

Solution:

- Determine Position Error Correction from figure B1-1 = 1010 feet
- Indicated Altitude = (Pressure altitude) — (altitude correction)

$$\text{Indicated altitude} = 20,000 \text{ ft} - 1010 \text{ ft}$$

$$\text{Indicated altitude} = 18,990 \text{ ft}$$

Therefore at an indicated airspeed of 400 knots an indicated altitude of 18,990 feet must be maintained on the altimeter to make good an assigned 20,000 feet pressure altitude.

STANDBY AIRSPEED POSITION ERROR CORRECTION

In order to obtain calibrated airspeed a correction for position error must be applied to the indicator reading. This correction is supplied from figure B1-2. When added algebraically to the indicated

airspeed, this correction yields calibrated airspeed (CAS).

Sample Problem

For the purpose of explaining the use of the Airspeed Position Correction Charts consider an aircraft flying at cockpit indicator values of 400 knots at 20,000 feet.

Given:

- Assigned Pressure Altitude = 20,000 feet.
- Indicated Airspeed = 400 knots.

Solution:

- Determine Airspeed Correction from figure B1-2 = 12.5 knots
- Calibrated Airspeed = (Indicated Airspeed) + (Airspeed Correction)
- Calibrated Airspeed = 400 + 12.5 knots
- Calibrated Airspeed = 412.5 KCAS

Therefore at an indicated airspeed of 400 knots and a pressure altitude of 20,000 feet the calibrated airspeed will be 412.5 knots.

When the standby instruments are corrected for their respective errors they will agree, within the system tolerances, with the tape indicated readings corrected for cam error.

IFIS AIRSPEED AND ALTITUDE CORRECTIONS

A mechanical cam in the central air data computer corrects the IFIS airspeed scale and altitude scale for position error. An additional correction for cam error must be applied to obtain true Mach number, calibrated airspeed and pressure altitude.

Sample Problem

Altitude

Given:

- Assigned Pressure Altitude = 20,000 feet
- Indicated Tape Airspeed = 400 knots

Solution:

- a. Determine Altitude Correction from figure B1-3 = 150 feet
- b. Tape altitude Reading = (Pressure Altitude) — (Altitude Correction)
- c. Tape Altitude Reading = 20,000 — 150 ft
- d. Tape Altitude Reading = 19,850 feet

To maintain 20,000 feet pressure altitude at an indicated tape airspeed of 400 knots the tape indicated altitude should read 19,850 feet.

Airspeed**Given:**

- a. Assigned Pressure Altitude = 20,000 ft
- b. Indicated Tape Airspeed = 400 knots

Solution:

- a. Determine Airspeed Correction from figure A1-3 = 2 knots
- b. Calibrated Airspeed = (Indicated Tape Airspeed) + (Airspeed Correction)
- c. Calibrated Airspeed = 400 + 2 knots
- d. Calibrated Airspeed = 402 knots

At a pressure altitude of 20,000 feet and indicated tape airspeed of 400 knots the calibrated airspeed is 402 knots.

Mach Number

- a. Indicated Tape Mach number = 0.85
- b. Determine Mach Correction from figure B1-3 = 0.006
- c. True Mach = (Indicated Tape Mach) + (Mach Correction)
- d. True Mach = 0.85 + 0.006 Mach
- e. True Mach = 0.856 Mach

STORE DRAG NUMBER AND AIRCRAFT CONFIGURATION DRAG INDEX

Store Drag Number and Gross Weight Table Figure B1-5 presents a partial listing of required external stores. A drag number has been assigned to each store for each aircraft position at which the store can be carried. Store drag numbers are given for single carriage of weapons and multiple carriage on MER where applicable. The drag index for a given configuration is the sum of the store drag numbers. Incremental weights for each external store are also shown on this table for use in determining the total aircraft weight.

EXAMPLE [947] N/C/W

Determine the configuration drag index for the following configuration: Six (6) M117 750 lb bombs on the centerline MER plus two (2) 450 gallon wing tanks plus two (2) M117 750 lb bombs on the outboard pylons.

From figure A1-5.

Two (2) 450 gallon tanks at inboard station.

Read for one (1) 450 gallon tank at inboard location a drag number of 14. The drag number for two (2) 450 gallon tanks is $2 \times 14 = 28$.

Read for one (1) M117 750 lb bomb at the outboard station in the presence of inboard station fuel tanks a drag number of 16. The drag number for two (2) M117 750 lb bombs at the outboard stations in the presence of inboard fuel tanks is $2 \times 16 = 32$.

Read for six (6) M117 750 lb bombs on centerline location a drag number of 75. As noted this drag number includes the MER required for carriage of six (6) M117 lb bombs on the centerline station.

The configuration drag index is the sum of the drag numbers $28 + 32 + 75 = 135$.

DRAG NUMBERS FOR ASYMMETRICAL WEIGHT TRIM DRAG

For configurations consisting of stores that result in a weight asymmetry an additional drag number must be determined for the additional drag due to the deflection of control surfaces required for trim. Figure B1-6 presents a chart from which this additional drag number may be determined for any given flight condition.

EXAMPLE

Determine the additional drag number for a weight asymmetry of 2000 lb for the following flight conditions: 30,000 feet pressure altitude at $M = 0.9$
Aircraft Gross Weight of 44,000 lb.

Enter figure B1-6 at (A) Net Weight Asymmetry of 2000 lb; move to (B) pressure altitude of 30,000 ft; move up to (C) Mach Number 0.9, proceed across to (D) aircraft Gross Weight of 44,000 lb; then down to (E) Mach Number of 0.9 and across to (F) and read an Incremental Drag Number of 20. This incremental drag number is added to the sum of the Store Drag Numbers to determine the total Configuration Drag Index.

AIRSPPEED, MACH NUMBER CONVERSION CHARTS

These charts show the relationship between calibrated airspeed, true airspeed and Mach number under any ambient conditions. The first chart covers speeds between 100 and 800 KCAS and Mach numbers from 0.3 through 1.2 The second chart goes up to 2.0 Mach number and 1000 KCAS. The use of

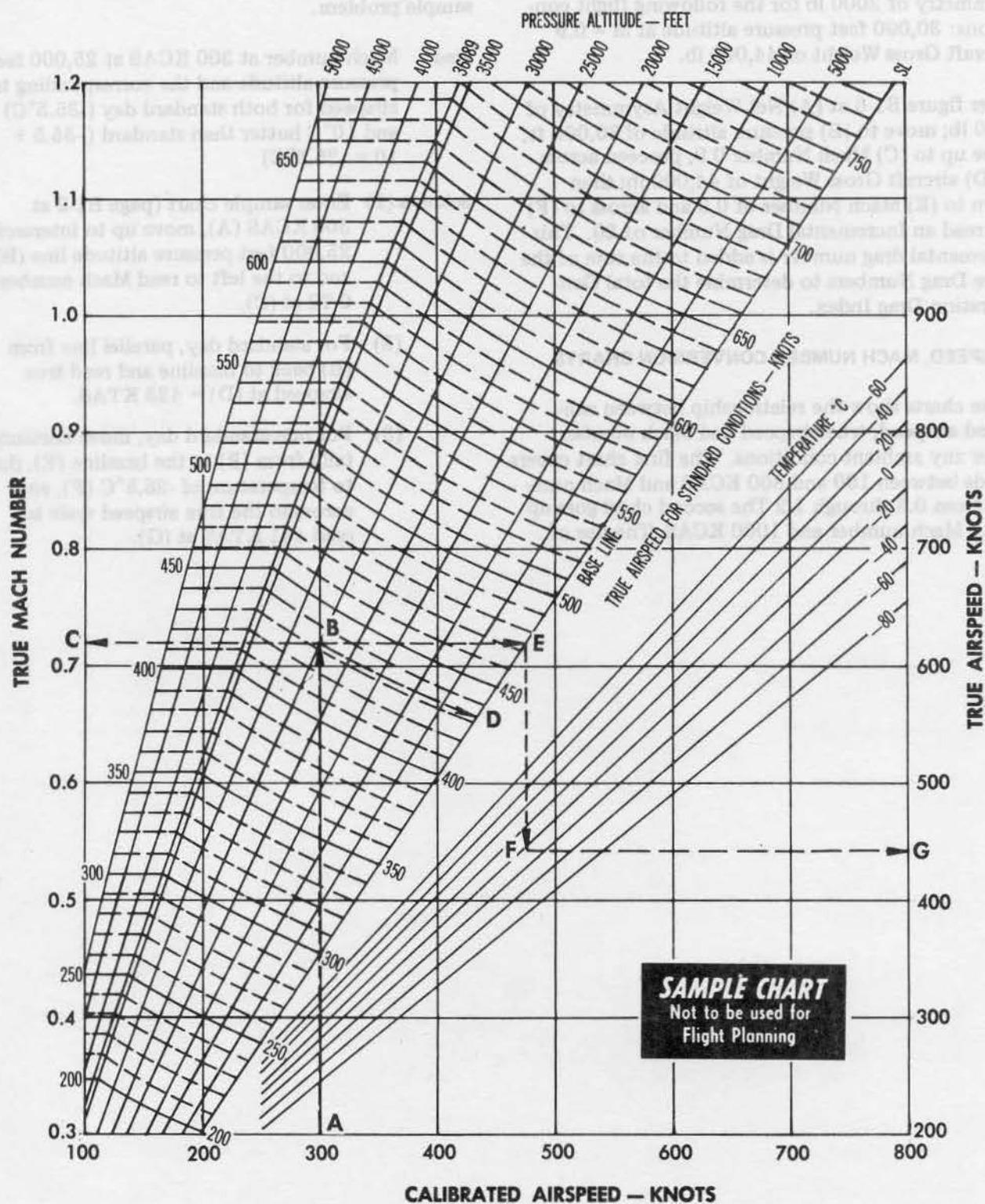
the conversion charts is illustrated in the following sample problem.

Find: Mach number at 300 KCAS at 25,000 feet pressure altitude and the corresponding true airspeed for both standard day (-35.5°C) and 10°C hotter than standard ($-35.5 + 10 = -25.5^{\circ}\text{C}$)

- Solution:** (1) Enter sample chart (page B1-2 at 300 KCAS (A), move up to intersect 25,000 feet pressure altitude line (B), and to the left to read Mach number = 0.72 at (C).
- (2) For standard day, parallel line from (B) back to baseline and read true airspeed at (D) = 433 KTAS.
- (3) For non-standard day, move horizontally from (B) to the baseline (E), down to temperature of -25.5°C (F), and across to the true airspeed scale to read 441 KTAS at (G).



AIRSPEED — MACH NUMBER CONVERSION CHART



**STANDBY ALTIMETER
POSITION ERROR CORRECTION
(NOSE BOOM)**

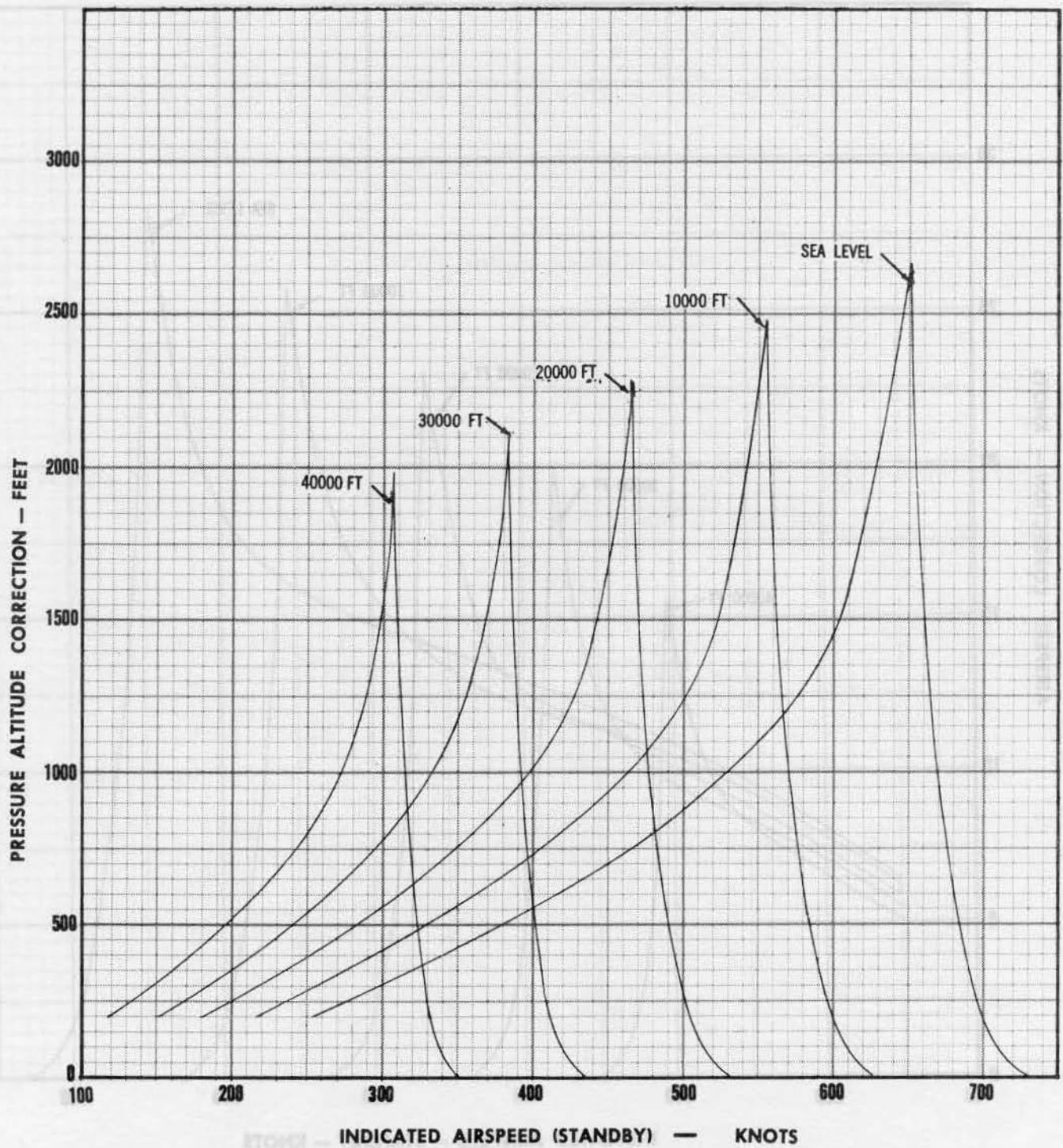


Figure B1-1



**STANDBY AIRSPEED INDICATOR
POSITION ERROR CORRECTION
(NOSE BOOM)**

NOTE

These curves are intended to be used
ONLY for aircraft in flight attitude,
NOT during ground roll.

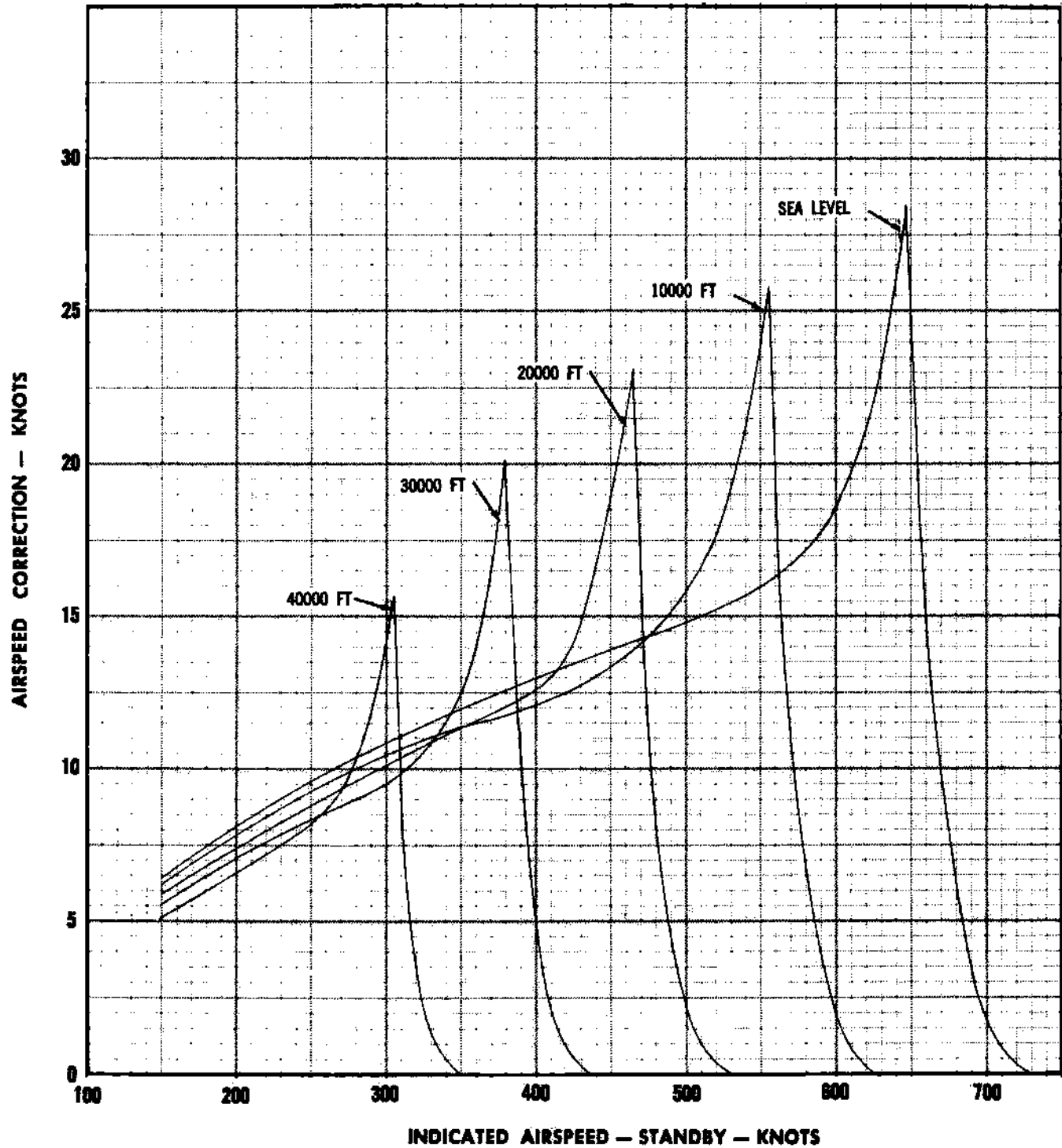


Figure B1-2

CORRECTIONS TO AMI AND AVVI READINGS AT TRUE PRESSURE ALTITUDE

F

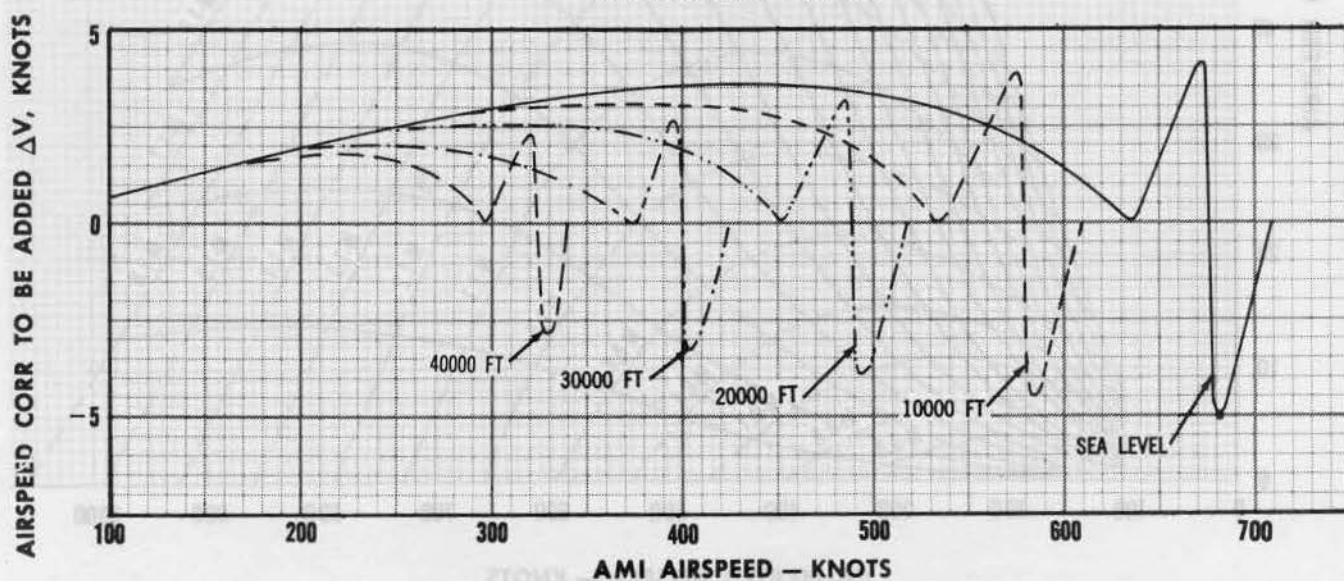
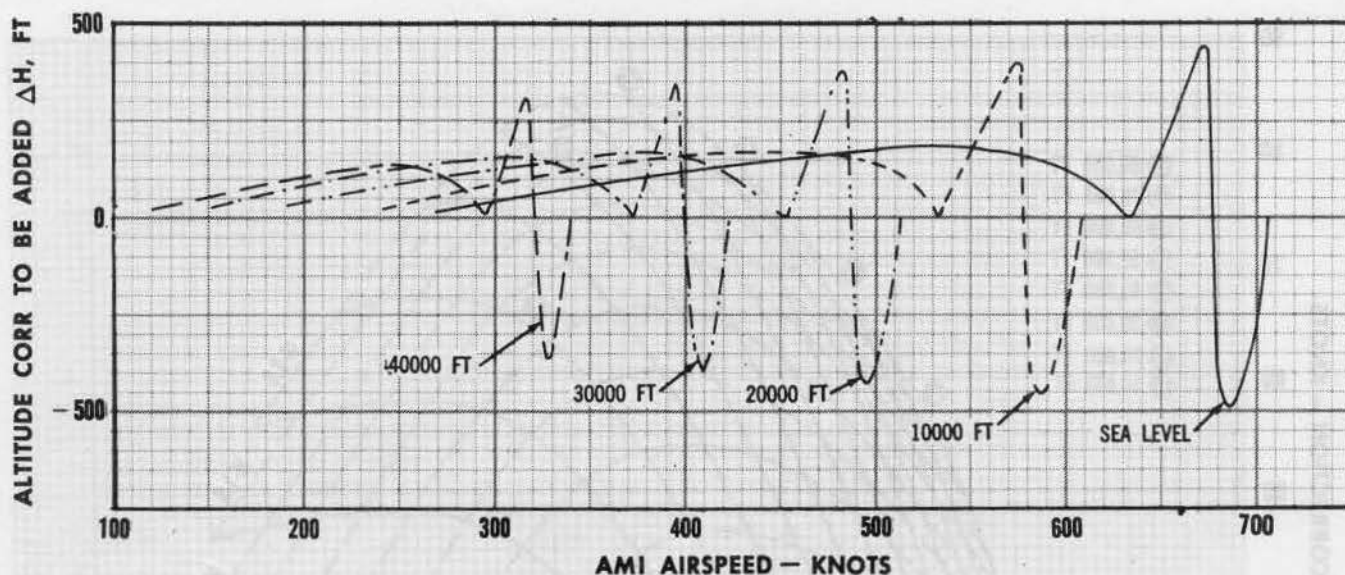
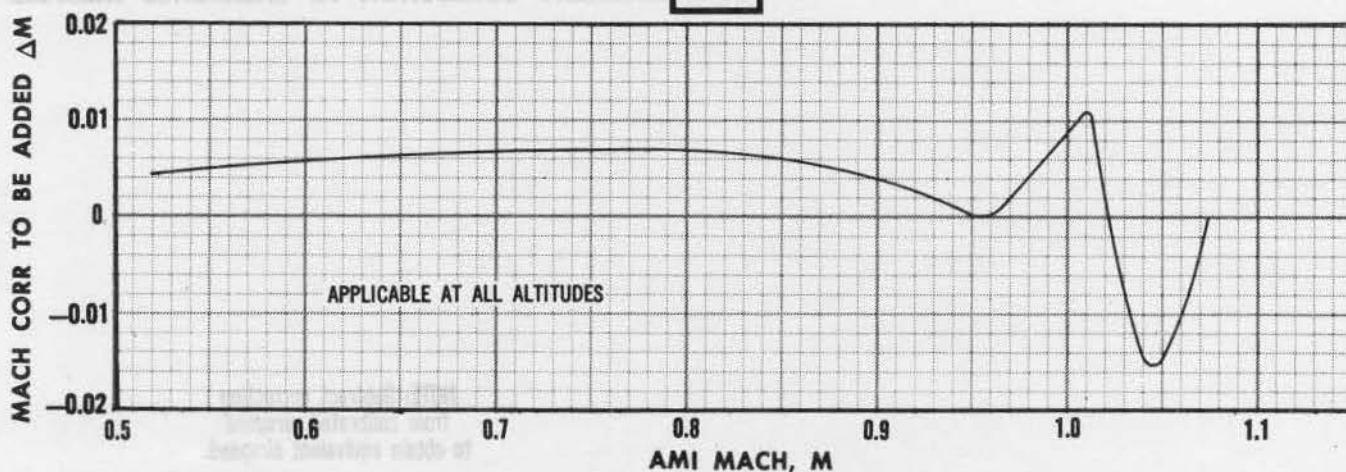


Figure B1-3

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

NOTE: Subtract correction from calibrated airspeed to obtain equivalent airspeed.

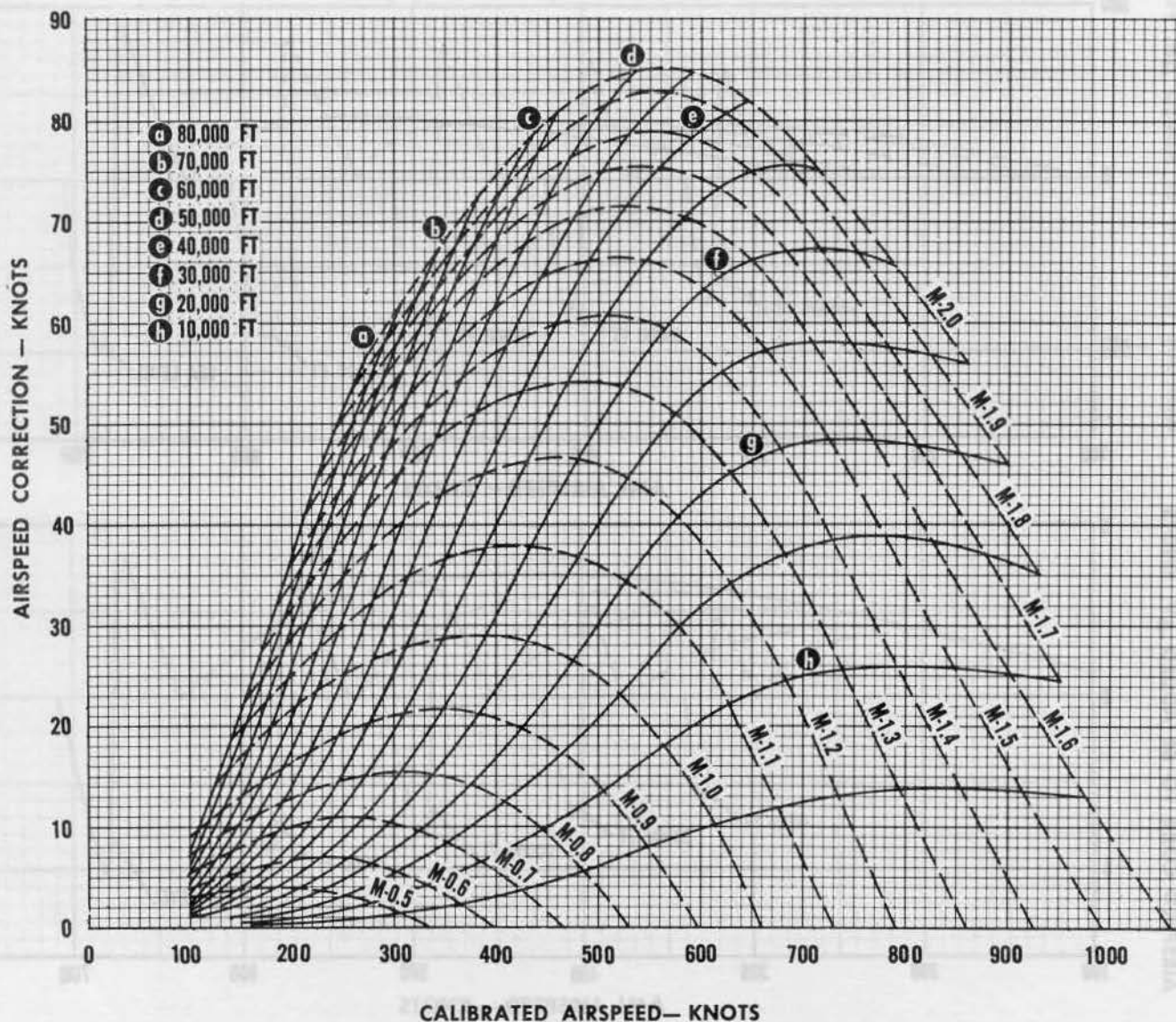


Figure B1-4

AVERAGE AIRCRAFT GROSS WEIGHTS AND DRAG NUMBERS



Clean without B/B tank, 7540
pounds of internal fuel. (Usable fuel)
Gross Wt. lb.

Drag
Number

Aircraft
B/B tank install (2535 lb. fuel)
Camouflage Paint
Wild Weasel III [F-516, F-522, F-522D] C/W
Wild Weasel I [982C] C/W

37505
150(2685)Ⓢ
150
254
148

20
—
8
6
3

STORE DRAG NUMBERS AND GROSS WEIGHTS

STORE	GROSS WEIGHT LB.	LOCATION			
		Centerline	Inboard	Outboard	
All Store Drag Nos. include necessary suspension equip.	(Store Only)			Inboard Clean	Inbd with store (Inbd Drag No. not included)
INTEGRAL PYLON FUEL TANKS					
(1) 650 Gallon (4225 lbs fuel)	Ⓐ 347(4572)Ⓢ	14Ⓢ			
(1) 450 Gallon (2925 lbs fuel)	Ⓐ 267(3192)Ⓢ Ⓑ 330(3255)Ⓢ	15	14 14		
SINGLE WEAPONS					
(1) M-117D Destructor	880			17	19
(1) M-117R 750 Lb. Retarded Bomb	880			17	19
(1) M-117 750 Lb. Bomb	823		14	13	16
(1) M-117 w/M1A1 fuze ext	823		14	13	16
(1) M-118 (T-55) Bomb	3049	17	19		
(1) MC-1 Chemical Bomb	725		14	13	16
(1) M-129 (T-58) Leaflet Bomb	200		14	13	16
(1) LAU-3/A Rocket Launcher	427		11	10	13
(1) LAU-18/A Rocket Launcher	450		11	10	13
(1) LAU-32A/A Rocket Launcher	47(173)Ⓢ		11	10	11
(1) LAU-59/A Rocket Launcher	48(173)Ⓢ		13	12	13
(1) SUU-21/A Practice Bomb Disp.	470(622)Ⓢ	12	18		
(6) MLU-32/B-99 Briteye Flare	900	40			
(1) BLU-1/B Firebomb	697		14	13	16
(1) BLU-27/B Firebomb (Finned)	870		15	14	17
(1) BLU-27/B Firebomb (Unfined)	857		14	13	16
(1) BLU-52/B Chemical Bomb	370	15	15	14	17
(1) M116A Firebomb	720		14	13	16
(1) CBU-1/A (Dispenser)	(752)Ⓢ			11	18
(1) CBU-1A/A (Dispenser)	(752)Ⓢ			11	18
(1) CBU-2/A (Dispenser)	(749)Ⓢ			11	18
(1) CBU-2A/A (Dispenser)	(828)Ⓢ			11	18
(1) CBU-2B/A (Dispenser)	(840)Ⓢ			11	18
(1) CBU-2C/A (Dispenser)	(877)Ⓢ			11	18
(1) CBU-3/A (Dispenser)	(658)Ⓢ			11	18
(1) CBU-3A/A (Dispenser)	(653)Ⓢ			11	18

Figure B1-5 (Sheet 1 of 5)

F

STORE DRAG NUMBERS AND GROSS WEIGHTS (Cont)

STORE	GROSS WEIGHT LB.	LOCATION			
		Centerline	Inboard	Outboard	
All Store Drag Nos. include necessary suspension equip.	(Store Only)			Inboard Clean	Inbd with store (Inbd Drag No. not included)
(1) SUU-20/A (empty)	245	22	24	24	37
(1) SUU-20/A(M) or SUU-20A/A (empty)	335	22	24	24	37
(1) SUU-20/A (4 FFAR)	315			24	37
(1) SUU-20/A(M) or SUU-20A/A (4 FFAR)	405			24	37
(1) SUU-20/A (4 FFAR, (6) 25 lb class bombs)	450		28		
(1) SUU-20/A (4 FFAR, (6) MK-106 practice bombs)	345		37		
(1) SUU-20/A(M) or SUU-20A/A (4 FFAR, (6) 25 lb class bombs)	540		28		
(1) SUU-20/A(M) or SUU-20A/A (4 FFAR, (6) MK-106 practice bombs)	435		37		
(1) SUU-20/A ((6) 25 lb class bombs)	375	26			
(1) SUU-20/A ((6) MK-106 practice bombs)	275	36			
(1) SUU-20/A(M) or SUU-20A/A ((6) 25 lb class bombs)	465	26			
(1) SUU-20/A(M) or SUU-20A/A ((6) MK-106 practice bombs)	365	36			

Figure B1-5 (Sheet 1A of 5)



STORE DRAG NUMBERS AND GROSS WEIGHTS (Cont)

STORE	GROSS WEIGHT LB.	LOCATION			
		Centerline	Inboard	Outboard	
All Store Drag Nos. include necessary suspension equip.	(Store Only)			Inboard Clean	Inbd with store (Inbd Drag No. not included)
(1) CBU-7/A (SUU-13/A Dispenser) with BLU-18/B Bomblets.	190(820)ⓐ	10		12	13
(1) CBU-24/B (Dispenser)	(830)ⓐ		14	13	16
(1) CBU-24A/B (Dispenser)	(830)ⓐ			13	16
(1) CBU-24B/B (Dispenser)	(832)ⓐ			13	16
(1) CBU-28/A (Dispenser)	188(461)ⓐ	10		12	13
(1) CBU-29/B (Dispenser)	(830)ⓐ		14	13	16
(1) CBU-29A/B (Dispenser)	(830)ⓐ			13	16
(1) CBU-29B/B (Dispenser)	(832)ⓐ			13	16
(1) CBU-30/A (Dispenser)	190(385)ⓐ	10		12	13
(1) CBU-37/A (Dispenser)	188(461)ⓐ	10		12	13
(1) CBU-46/A (Dispenser)	(877)ⓐ			11	18
(1) CBU-49/B (Dispenser)	(830)ⓐ		14	13	16
(1) CBU-49A/B (Dispenser)	(830)ⓐ			13	16
(1) CBU-49B/B (Dispenser)				13	16
(1) CBU-53/B (Dispenser)	(832)ⓐ			13	16
(1) CBU-54/B (Dispenser)	(832)ⓐ			13	16
(1) MK-82 (Snakeye)	560		15	14	14
(1) MK-82 (Bomb)	531		11	10	11
(1) MK-83 (Bomb)	985		12	11	14
(1) MK-84 (Bomb)	1970	13	15		
(1) MA-2 Rocket Launcher	25(65)ⓐ		9	8	8
(1) AGM-12B (Missile)	567-593ⓑ		10	10	13
(1) AGM-12C (Missile)	1779		18		
(1) AGM-45A (Shrike)	392			6	8
(1) AGM-78A (Missile)	1354		25		
(1) AGM-78B (Missile)	1360		25		
(1) QRC-160-1 Pod	200			5	8
(1) QRC-160-2 Pod	185			5	8
(1) QRC-160-8 Pod	300			5	8
(1) QRC-335A with RATG	317			5	8
(1) QRC-335A without RATG	242			5	8
(1) A/B-45Y-2 Spray Tank	488 (793) TX Agentⓐ (561) LX Agentⓐ			12	30
(1) AN/ALE-2 Chaff Dispenser	205(425)ⓐ			11	26
(1) BDU-4/B or Parent Weapon	—	15	17		
(1) MD-6 or Parent Weapon	—	15	17		
(1) BDU-8/B (Long or short nose) With drag ring	—	22	29		
No drag ring		17	19		

NOTES:

- ⓐ Integral Tank and Pylon, Centerline
 ⓑ Integral Tank and Pylon, Wing Inboard
 ⓒ Empty (Maximum Full)

ⓓ Range of Weight depending on type AGM-12B

ⓔ This store drag number (14) for the F-105F has been determined from flight tests to be less than that for the F-105D.

Figure B1-5 (Sheet 2 of 5)

F**STORE DRAG NUMBERS AND GROSS WEIGHTS (Cont)**

STORE	GROSS WEIGHT LB.	LOCATION			
		Centerline	Inboard	Outboard	
All Store Drag Nos. include necessary suspension equip.	(Store Only)			Inboard Clean	Inbd with store (Inbd Drag No. not included)
MULTIPLE WEAPONS					
(3) M-117D Destructor	2640	67			
(3) M-117 750 Lb. Retarded Bomb	2640	67			
(6) M-117 750 Lb. Bombs	4938	75			
(6) M-117 w/M1A1 fuze ext	4938	75			
(4) M-117 750 Lb. Bombs	3292	52	40		
(6) MC-1 Chemical Bombs	4350	75			
(4) MC-1 Chemical Bombs	2900	52	40		
(6) M-129 (T-58) Bombs	1200	75			
(4) M-129 (T-58) Bombs	800	52	40		
(2) LAU-3 /A Rocket Launchers	854		38		
(2) LAU-18 /A Rocket Launchers	900		38		
(2) LAU-32A /A Rocket Launchers	346		25		
(2) LAU-59 /A Rocket Launchers	346		28		
(3) BLU-1 /B Firebombs	2091	42			
(2) BLU-1 /B Firebombs	1394	23	27		
(2) BLU-27 /B Firebomb (Finned)	1740	25	29		
(2) BLU-27 /B Firebomb (Unfinned)	1714	23	27		
(2) BLU-52 /B Chemical Bomb	740	25	27		
(3) M116A Firebombs	2160	42			
(2) M116A Firebombs	1440	23	27		
(5) CBU-24 /B Dispenser	4150	68			
(4) CBU-24 /B Dispenser	3320	52			
(5) CBU-24A /B Dispenser	4150	68			
(4) CBU-24A /B Dispenser	3320	52			
(5) CBU-24B /B Dispenser	4160	68			
(4) CBU-24B /B Dispenser	3328	52			
(5) CBU-29 /B	4150	68			
(4) CBU-29 /B Dispenser	3320	52			
(5) CBU-29A /B Dispenser	4150	68			
(4) CBU-29A /B Dispenser	3320	52			
(5) CBU-29B /B Dispenser	4160	68			
(4) CBU-29B /B Dispenser	3328	52			
(5) CBU-49 /B Dispenser	4150	68			
(4) CBU-49 /B Dispenser	3320	52			
(5) CBU-49A /B Dispenser	4150	68			
(4) CBU-49A /B Dispenser	3320	52			
(5) CBU-49B /B Dispenser	4160	68			
(4) CBU-49B /B Dispenser	3328	52			
(5) CBU-53 /B Dispenser	4160	68			
(4) CBU-53 /B Dispenser	3328	52			
(5) CBU-54 /B Dispenser	4160	68			
(4) CBU-54 /B Dispenser	3328	52			

Figure B1-5 (Sheet 3 of 5)

F**STORE DRAG NUMBERS AND GROSS WEIGHTS (Cont)**

STORE	GROSS WEIGHT LB.	LOCATION			
		Centerline	Inboard	Outboard	
All Store Drag Nos. include necessary suspension equip.	(Store Only)			Inboard Clean	Inbd with store (Inbd Drag No. not included)
(6) MK-82 (Snakeye)	3360	57			
(4) MK-82 (Snakeye)	2240	41	39		
(3) MK-82 (Snakeye)	1680	44			
(2) MK-82 (Snakeye)	1120		31		
(6) MK-82 (Bomb)	3186	45			
(4) MK-82 (Bomb)	2124	33	31		
(3) MK-83 (Bomb)	2955	31			
(2) MK-83 (Bomb)	1970	17	23		
(2) AIM-9B Sidewinders	310			13	24
(2) AIM-9E Sidewinders	310			13	24
SUU-20A/A (Rockets)				24	37
SUU-20A/A (Rockets) 6 MK-26 (Bombs)			28		
SUU-20A/A (Rockets) 6 MK-106 (Bombs)			37		
SUU-20A/A (Rockets)			24		
SUU-20A/A Clean		22			
SUU-20A/A (No Rockets) 6 MK-76 (Bombs)		26			
SUU-20A/A (No Rockets) 6 MK-106 (Bombs)		36			
MK-61		10	12	12	12
(1) BLU-31/B	800			28	33
(2) BLU-31/B	1600		44		
(3) BLU-31/B	2400	47			

Figure B1-5 (Sheet 4 of 5)



STORE DRAG NUMBERS

Pylons or Racks Only — No Ordnance

PYLONS	CENTERLINE	INBOARD	OUTBOARD
(1) Multi-Weapon or Universal Pylon with Multi Ejector Rack	13	14	—
(1) Centerline MER Pylon with Multi Ejector Rack	15	—	—
(1) Multi-Weapon or Universal Pylon only	3	6	4
(1) Special Pylon for AGM-12B	—	3	2
(1) Special Pylon, Adapter and Launcher for (2) AIM-9B	—	—	3
(1) Launcher Adapter on Inboard AGM-78 Pylon (modified MWP)	—	7	—

STORE WEIGHTS (LB)

Pylons or Racks Only — No Ordnance

PYLONS AND RACKS	CENTERLINE	INBOARD	OUTBOARD
(1) Universal Pylon, 14" Rack ®	—	202	132
(1) Universal Pylon, 30" Rack ®	—	239	—
(1) Multiple Weapon Pylon	342	245	—
(1) Centerline MER Pylon	126	—	—
(1) Special Pylon for AGM-12B with Adapter	—	147	131
(1) Special Pylon for (2) AIM-9B with Adapter & Launcher	—	—	151
(1) Multiple Ejector Rack On Multi-Weapon or Universal Pylon (4 position)	172	172	—
On Centerline MER Pylon (6 position)	198	—	—
(1) AGM-78 Pylon (modified MWP) plus Launcher	—	432	—

® For Direct Loaded Conventional Weapons Only

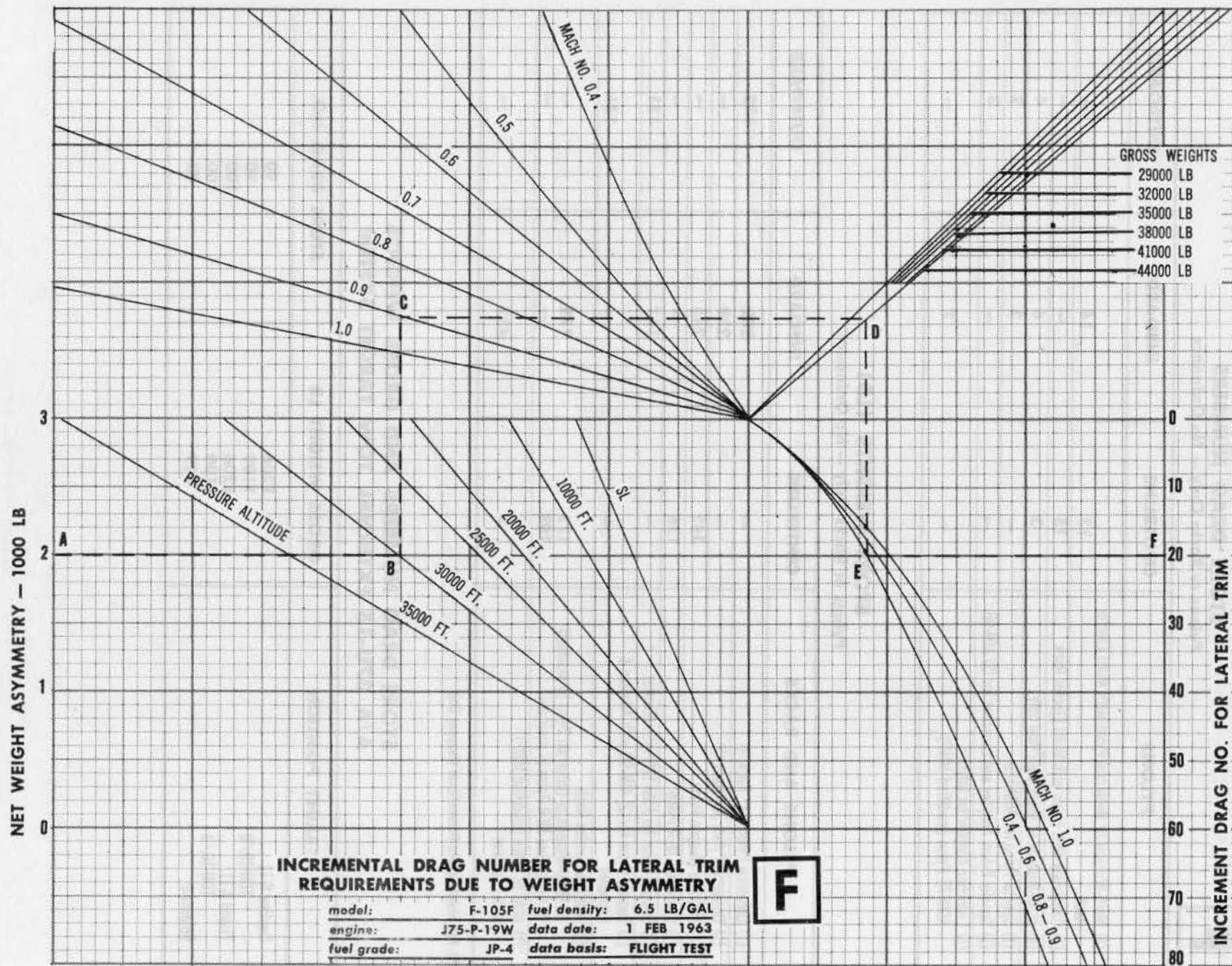
STORE DRAG NUMBERS AND GROSS WEIGHTS

A/A 37U-15 EXTERNAL TOW TARGET SYSTEM

TARGET POSITION	GROSS WEIGHT LB	STORE DRAG NO.
Captive K-11	1206	90
TDU-10/B	1199	90
Towed K-11	1206	100
TDU-10/B	1199	100
Released	829	33

Figure B1-5 (Sheet 5 of 5)

Figure B1-6



AIRSPEED — MACH NUMBER CONVERSION CHART

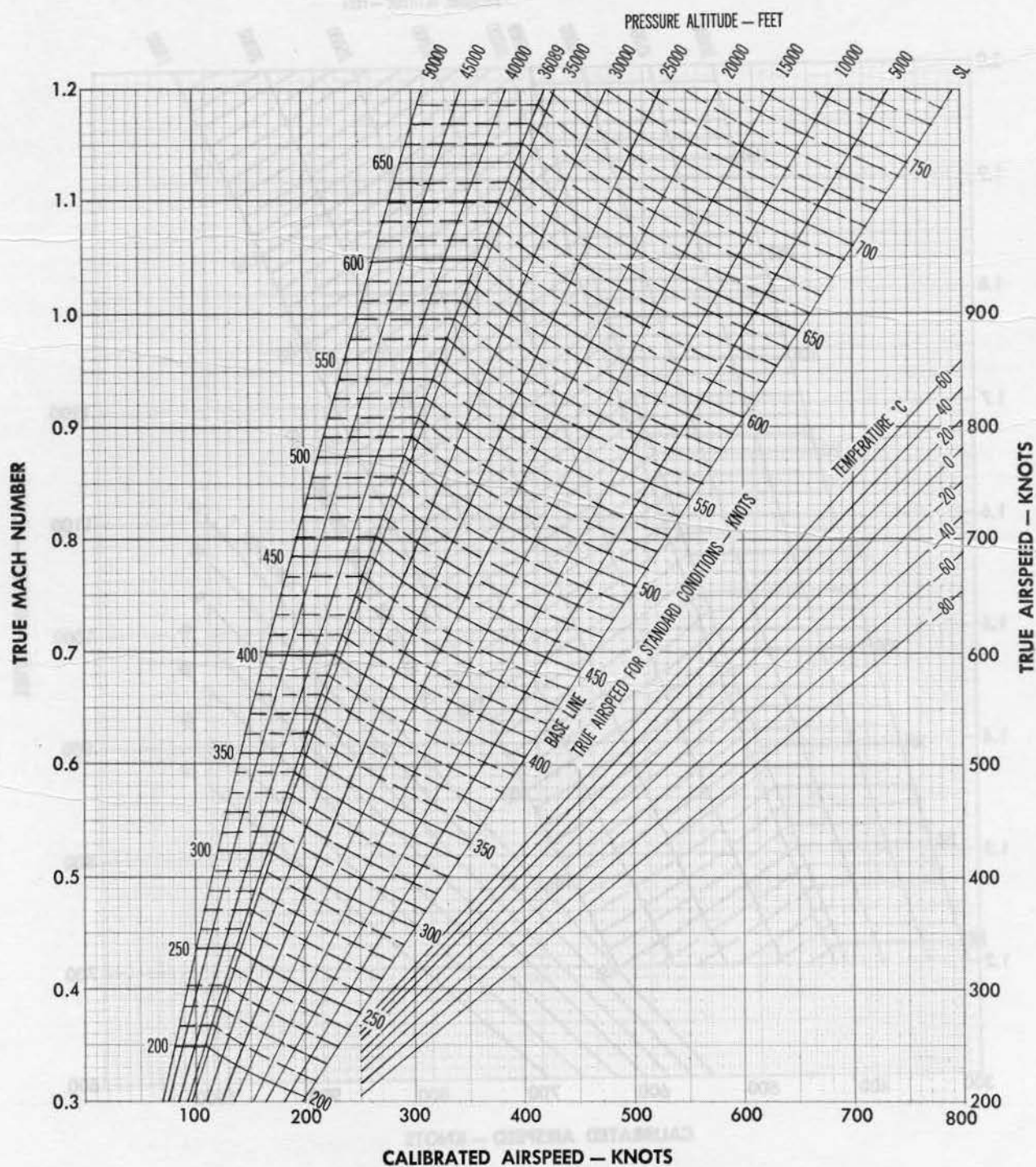


Figure B1-7 (Sheet 1 of 2)



AIRSPEED — MACH NUMBER CONVERSION CHART

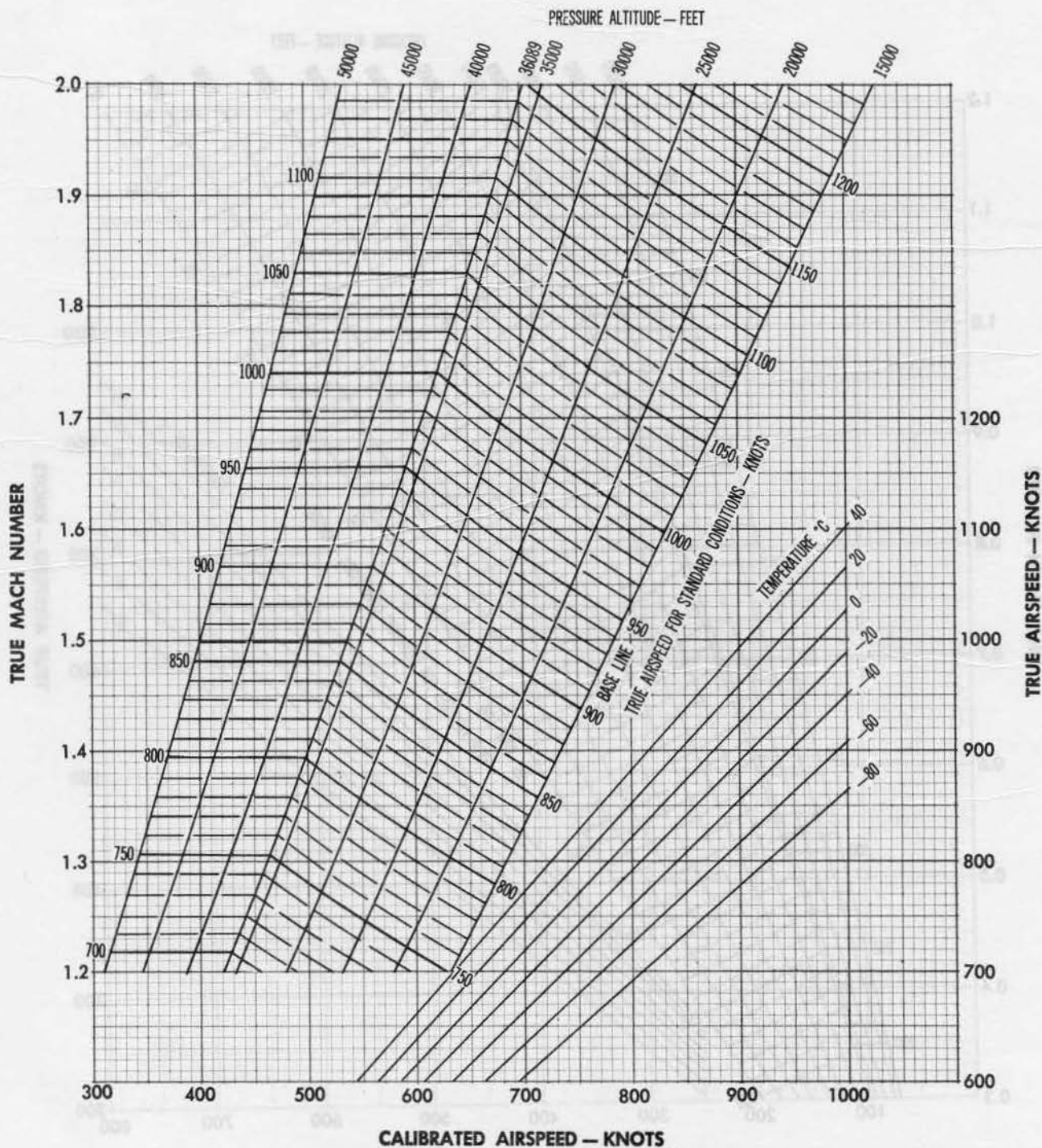


Figure B1-7 (Sheet 2 of 2)

TEMPERATURE CORRECTION FOR COMPRESSIBILITY

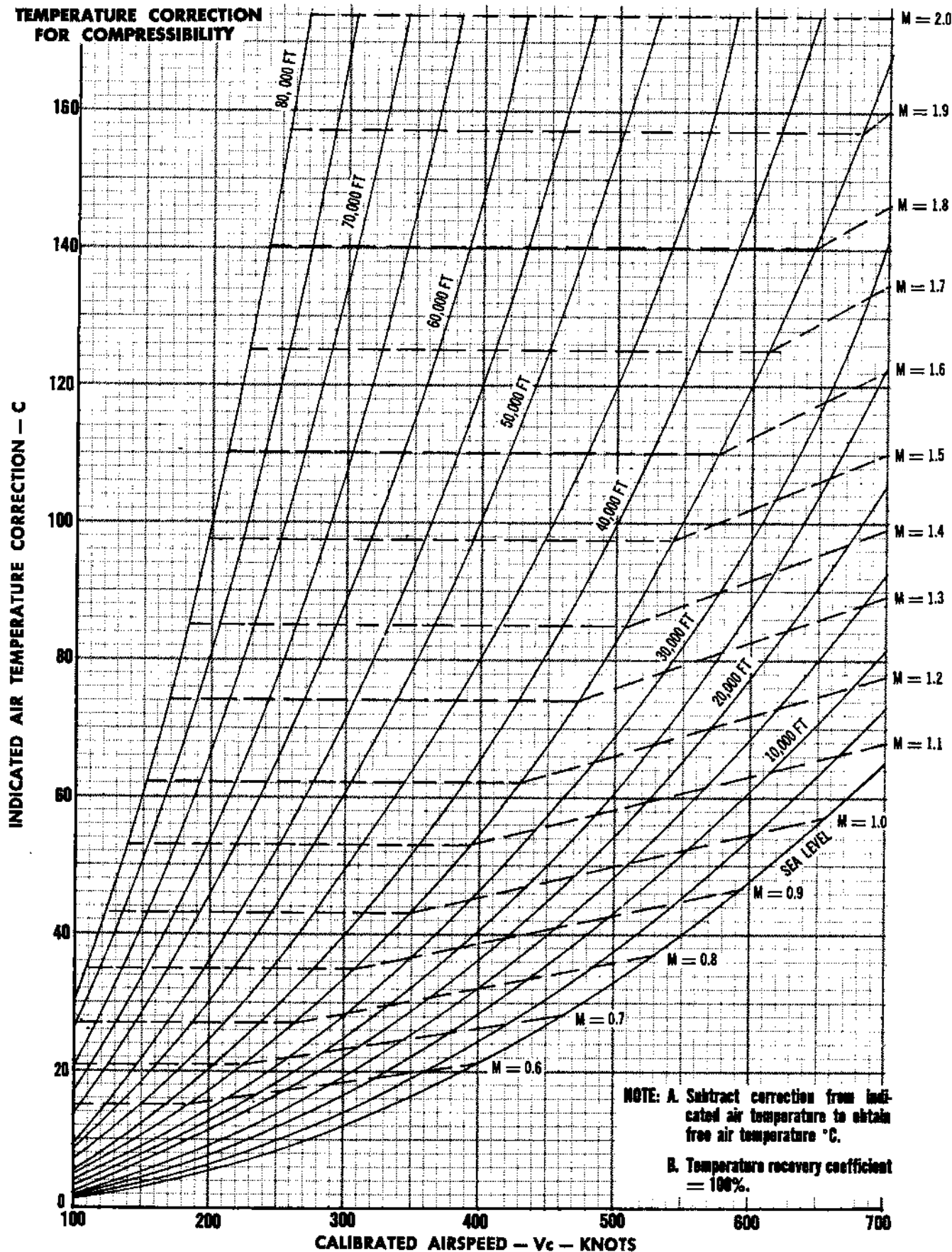


Figure B1-8

ICAO DENSITY ALTITUDE CHART

INTERNATIONAL STANDARD ATMOSPHERE

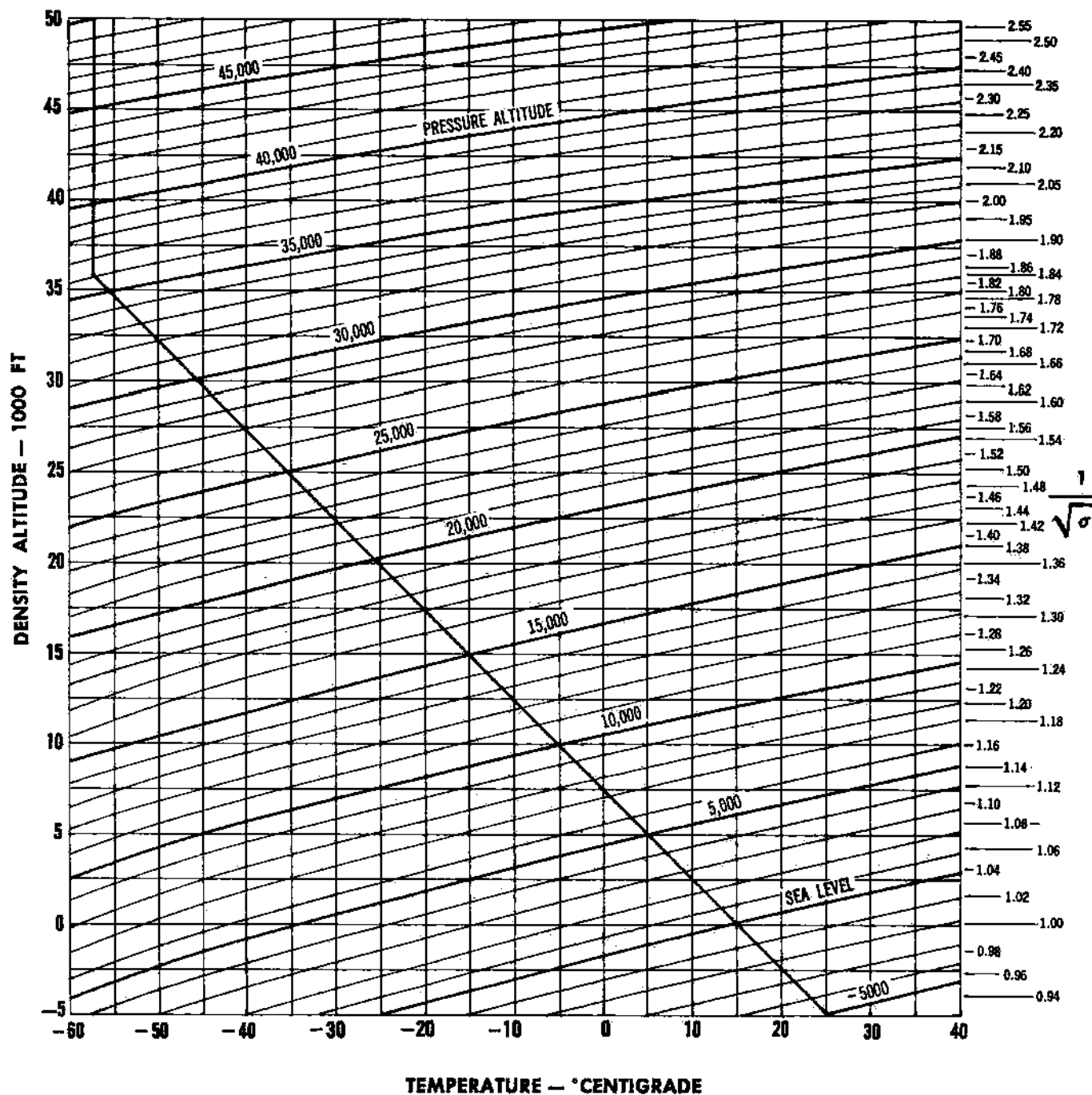


Figure B1-9

STANDARD ATMOSPHERE
table

STANDARD ATMOSPHERE

table

(ICAO)

Standard SL Conditions

TEMPERATURE 15°C (59°F)
PRESSURE 29.921 IN. Hg 2116.216 LB/SQ FT
DENSITY .0023769 SLUGS/CU FT
SPEED OF SOUND 1116.89 FT/SEC 661.7 KNOTS

Conversion Factors

1 IN. Hg 70.727 LB/SQ FT
1 IN. Hg 0.49116 LB/SQ IN.
1 KNOT 1.151 MPH
1 KNOT 1.688 FT/SEC

ALTITUDE FEET	DENSITY RATIO σ	$\sigma^{-1/2}$ $\frac{1}{\sqrt{\sigma}}$	TEMPERATURE		SPEED OF SOUND KNOTS	PRESSURE IN. Hg	PRESSURE RATIO δ
			°C	°F			
0	1.000	1.0000	15.000	59.000	661.7	29.921	1.0000
1000	.9711	1.0148	13.019	55.434	659.5	28.856	.9644
2000	.9428	1.0299	11.038	51.868	657.2	27.821	.9298
3000	.9151	1.0454	9.056	48.302	654.9	26.817	.8962
4000	.8881	1.0611	7.076	44.735	652.6	25.842	.8637
5000	.8617	1.0773	5.094	41.169	650.3	24.896	.8320
6000	.8359	1.0938	3.113	37.603	648.7	23.978	.8014
7000	.8106	1.1107	1.132	34.037	645.6	23.088	.7716
8000	.7860	1.1279	-0.850	30.471	643.3	22.225	.7428
9000	.7620	1.1456	-2.831	26.905	640.9	21.388	.7148
10,000	.7385	1.1637	-4.812	23.338	638.6	20.577	.6877
11,000	.7155	1.1822	-6.793	19.772	636.2	19.791	.6614
12,000	.6932	1.2011	-8.774	16.206	633.9	19.029	.6360
13,000	.6713	1.2205	-10.756	12.640	631.5	18.292	.6113
14,000	.6500	1.2403	-12.737	9.074	629.0	17.577	.5875
15,000	.6292	1.2606	-14.718	5.508	626.6	16.886	.5643
16,000	.6090	1.2815	-16.699	1.941	624.2	16.216	.5420
17,000	.5892	1.3028	-18.680	-1.625	621.8	15.569	.5203
18,000	.5699	1.3246	-20.662	-5.191	619.4	14.942	.4994
19,000	.5511	1.3470	-22.643	-8.757	617.0	14.336	.4791
20,000	.5328	1.3700	-24.624	-12.323	614.6	13.750	.4595
21,000	.5150	1.3935	-26.605	-15.889	612.1	13.184	.4406
22,000	.4976	1.4176	-28.587	-19.456	609.6	12.636	.4223
23,000	.4806	1.4424	-30.568	-23.022	607.1	12.107	.4046
24,000	.4642	1.4678	-32.549	-26.588	604.6	11.597	.3876
25,000	.4481	1.4938	-34.530	-30.154	602.1	11.103	.3711
26,000	.4325	1.5206	-36.511	-33.720	599.6	10.627	.3552
27,000	.4173	1.5480	-38.492	-37.286	597.1	10.168	.3398
28,000	.4025	1.5762	-40.474	-40.852	594.6	9.725	.3250
29,000	.3881	1.6052	-42.455	-44.419	592.1	9.297	.3107
30,000	.3741	1.6349	-44.436	-47.985	589.5	8.885	.2970

Figure B1-10 (Sheet 1 of 2)

T.O. 1F-105D-1

STANDARD ATMOSPHERE
table

ALTITUDE FEET	DENSITY RATIO σ	$\sigma - 1/2$ $\frac{1}{\sqrt{\sigma}}$	TEMPERATURE		SPEED OF SOUND KNOTS	PRESSURE IN. Hg	PRESSURE RATIO δ
			°C	°F			
31,000	.3605	1.6654	-46.417	-51.551	586.9	8.488	.2837
32,000	.3473	1.6968	-48.398	-55.117	584.4	8.106	.2709
33,000	.3345	1.7291	-50.379	-58.683	581.8	7.737	.2586
34,000	.3220	1.7623	-52.361	-62.249	579.2	7.382	.2467
35,000	.3099	1.7964	-54.342	-65.816	576.6	7.041	.2353
36,000	.2981	1.8315	-56.323	-69.382	574.0	6.712	.2243
36,089	.2971	1.8347	-56.500	-69.700	573.7	6.683	.2234
37,000	.2843	1.8753				6.397	.2138
38,000	.2710	1.9209				6.097	.2038
39,000	.2583	1.9677				5.811	.1942
40,000	.2462	2.0155				5.538	.1851
41,000	.2346	2.0645	-56.500	-69.700	573.7	5.278	.1764
42,000	.2236	2.1148				5.030	.1681
43,000	.2131	2.1662				4.794	.1602
44,000	.2031	2.2189				4.569	.1527
45,000	.1936	2.2728				4.355	.1455
46,000	.1845	2.3281				4.151	.1387
47,000	.1758	2.3848				3.956	.1322
48,000	.1676	2.4428				3.770	.1260
49,000	.1597	2.5022				3.593	.1201
50,000	.1522	2.5630				3.425	.1145
51,000	.1451	2.6254				3.264	.1091
52,000	.1383	2.6892				3.111	.1040
53,000	.1318	2.7546				2.965	.09909
54,000	.1256	2.8216				2.826	.09444
55,000	.1197	2.8903				2.693	.09001
56,000	.1141	2.9606				2.567	.08578
57,000	.1087	3.0326				2.446	.08176
58,000	.1036	3.1063				2.331	.07792
59,000	.09877	3.1819				2.222	.07426
60,000	.09414	3.2593				2.118	.07078
61,000	.08972	3.3386	-56.500	-69.700	573.7	2.018	.06746
62,000	.08551	3.4198				1.924	.06429
63,000	.08150	3.5029				1.833	.06127
64,000	.07767	3.5881				1.747	.05840
65,000	.07403	3.6754				1.665	.05566
66,000	.07055	3.7649				1.587	.05305
67,000	.06724	3.8564				1.513	.05056
68,000	.06409	3.9502				1.442	.04819
69,000	.06108	4.0463				1.374	.04592
70,000	.05821	4.1447				1.310	.04377
71,000	.05548	4.2456				1.248	.04171
72,000	.05288	4.3488				1.190	.03976
73,000	.05040	4.4545				1.134	.03789
74,000	.04803	4.5633				1.081	.03611
75,000	.04578	4.6738				1.030	.03442
76,000	.04363	4.7874				0.982	.03280
77,000	.04158	4.9039				0.935	.03126
78,000	.03963	5.0231				0.892	.02980
79,000	.03777	5.1454				0.850	.02840
80,000	.03600	5.2706				0.810	.02707

Figure B1-10 (Sheet 2 of 2)

TEMPERATURE CONVERSION CHART

DEGREES FAHRENHEIT

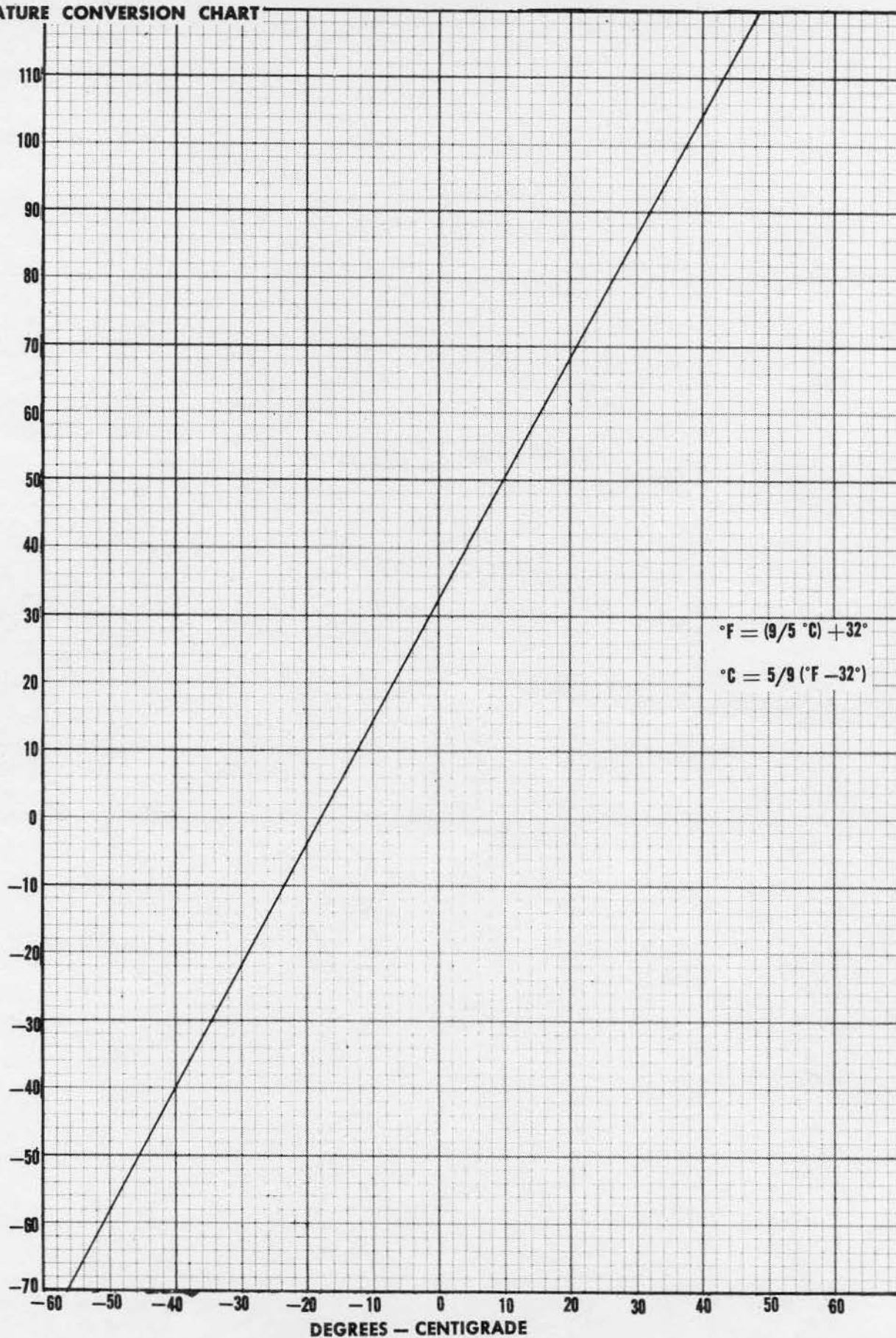


Figure B1-11

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TAKEOFF PLANNING.

This part covers the information and charts to be used to obtain takeoff speeds and distances. The terms used in the planning procedure are defined in the following paragraphs. Takeoff performance is affected by a large number of variables, i.e., temperature, altitude, gross weight, and wind, as well as runway surface, use of brakes for directional control, and engine condition. Charts including those variables are provided for takeoff distance, acceleration distance and speed, stopping distance or refusal speed, and minimum afterburner blow-out speeds. Increases in any of these variables except wind tend to increase takeoff ground run to a point where, on a takeoff in which normal techniques are used, the takeoff may not be successfully made in the available runway length. The takeoff chart shows distances for ground run as well as air distances required to clear 50 through 200 foot obstacle heights, takeoff speeds, and rotation speeds. The velocity during takeoff ground run charts show the speed-distance relationship during

the ground run portion of takeoff before rotation speed is reached. The refusal speed chart shows the combined distance traveled in acceleration to any given refusal speed and the distance required for a FULL stop. The minimum afterburner blow-out speeds chart shows the minimum afterburner failure speeds at which takeoff can be continued with Military Thrust without exceeding the available runway length. The takeoff cross wind chart shows the crosswind limits for aircraft gross weight.

The use of these charts for takeoff planning is illustrated by a sample problem.

Note

Use 50 percent of reported headwinds and 150 percent of reported tailwinds with the takeoff crosswind chart if wind is measured at a source other than the runway.

RUNWAY DISTANCE MARKING SYSTEM

The numbering and placement of runway distance markers reflects the distance remaining to the end of the runway in 1000-foot increments. These markers are placed alongside the runway, and the appropriate markers become the acceleration check distance marker and the go, no-go distance marker. The markers are so placed that if a runway length exceeds an even number of thousands of feet, one half of the excess must be added to the distance shown on the markers to determine the actual distance remaining. For example, if a runway is 10,500 ft., the distance remaining at the No. 6 Marker would be $6000 + 1/2(500) = 6250$ ft.

ROTATION SPEED (NOSE WHEEL-OFF)

Rotation Speed (nose wheel-off) is the airspeed at which the nose wheel leaves the runway. The calibrated airspeed (CAS) for rotation is shown at various gross weights.

TAKEOFF SPEED

Takeoff Speed is the airspeed at which the main wheels leave the runway. The calibrated airspeed (CAS) for takeoff is shown at various gross weights.

TAKEOFF INDEX

Takeoff Index is a temperature-altitude factor which is read for the thrust setting used for takeoff. All Takeoff Performance Charts except the Velocity During Takeoff Ground Run and the Air Distance Charts are shown as a function of Takeoff Index.

CLIMB-OUT INDEX

Climb-out Index is a temperature-altitude factor which is read for the thrust setting used for takeoff. Air distances required to clear 50 through 200 foot obstacle heights are shown as a function of Climb-out Index.

TAKEOFF DISTANCES

Ground run distances and air distances to clear 50 through 200 foot obstacle heights with Maximum and Military Thrust are plotted on the takeoff distance charts as functions of Takeoff Index and Climb-out Index, respectively. The distances shown are for normal takeoff techniques on a dry, hard-surface runway and may be used for any configuration if the gross weight at takeoff is considered. These charts account for ambient temperature and

pressure altitude through the index method of presentation. The effect of the remaining variables of gross weight, headwind or tailwind, runway slope (ground run chart) and obstacle height (air distance chart) are also shown. Separate charts are provided for ground run and air distance performance.

Incremental drag for externally loaded configurations has been accounted for at various aircraft gross weights.

TAKEOFF ACCELERATION

Velocity During Takeoff Ground Run

The velocity during takeoff ground run figures B2-4 and B2-5) charts give ground run distances required to accelerate to any desired calibrated airspeed using Maximum or Military Thrust. These distances are based on the normal takeoff techniques given in Section II and do not take into account standard engines or excessive use of brakes for directional control.

Refusal Speeds

The highest indicated airspeed to which the aircraft can accelerate and then stop in the available runway length is the refusal speed. The refusal speed chart is based on a Maximum or Military Thrust acceleration to the refusal speed, and then heavy braking to a stop with or without the use of a drag chute. The drag chute reduces the distance required to stop and should be used if possible. The effect of Runway Condition (RCR) (see page B8-1 for explanation of RCR) on refusal speed is also shown. These charts take into account gross weight, external loading as a function of gross weight, and, through the Takeoff Index, pressure altitude and temperature.

MINIMUM AFTERBURNER BLOW-OUT SPEEDS

The lowest indicated airspeed to which the aircraft can accelerate with Maximum Thrust, experience a Maximum Thrust failure, and complete the takeoff with Military Thrust without exceeding the available runway length is the minimum afterburner blow-out speed. The speeds shown on the chart were determined for the clean and externally loaded configurations and are shown for all conditions of gross weight, runway length and wind. Pressure altitude and temperature are accounted for by the Takeoff Index.

WARNING

These speeds are applicable only if the throttle is moved out of the afterburner position immediately, to enable the afterburner nozzle to close. Non-afterburner engine operation with the nozzle open will result in large thrust losses and therefore in significantly longer takeoff distances.

TAKEOFF CROSSWIND CHART

The most critical point in a takeoff with a crosswind is just after lifting the nosewheel and is based on the maximum sideslip angle that the rudder can hold. The takeoff crosswind chart shown in figure B2-9 is based on this consideration. To use this chart, it is required that the aircraft weight, wind direction and velocity be known. An example is given to illustrate the use of the chart. It can be seen that the intersection of two lines should fall in the "recommended" area for a normal takeoff. By normal takeoff it is meant that no overspeed is required. If the intersection falls in the "not recommended" area, takeoff may be achieved if it is seen that some overspeed will place the nosewheel lift-off speed back in the "recommended" area. The amount of overspeed permissible is limited and is a matter of pilot judgment as to what speed he may hold the nosewheel on the ground. After nosewheel lift-off, the ability of the rudder to hold a sideslip angle becomes less critical with increasing angle of attack up to takeoff altitude. After being airborne, the limiting factor in holding a sideslip angle is the lateral control. However, once the aircraft has lifted off, there is no longer any need to hold a sideslip angle, i.e., the aircraft heading may be changed with the rudder to effect any desired path across the ground. No attempt should be made to hold a sideslip angle after takeoff, particularly with large crosswind, because the lateral control cannot keep the wings level when the rudder is fully deflected and because the spoiler causes loss in lift. During the takeoff ground run, the inherent stability of the tricycle landing gear at high speed and the nosewheel steering at low speed eliminate any difficulties from cross wind. The rudder may be used during the ground run, but excessive lateral control deflections will aggravate rather than help the situation.

REFUSAL DISTANCE

The refusal distance is the distance required to accelerate to the refusal speed and is obtained from the velocity during takeoff ground run charts.

GO, NO-GO DISTANCE

Go, no-go distance is defined as the distance traveled in reaching the last 1000-foot runway marker short of the refusal distance. This is the point at which the final decision to continue or to abort the takeoff is made. The minimum speed attained at the go, no-go distance marker is defined as the go, no-go speed and is obtained by subtracting the go, no-go speed tolerance from the normal speed at the go, no-go distance.

GO, NO-GO SPEED TOLERANCE

Speed tolerance is the maximum speed deficiency that is acceptable at the go, no-go distance marker to ensure a safe takeoff in 90 percent of the available runway. If acceleration is deficient to the extent that the speed tolerance is exceeded at the go, no-go distance, a serious malfunction of the aircraft is indicated and the takeoff should be aborted.

ACCELERATION CHECK DISTANCE

The final decision to continue or to abort a takeoff is made at the go, no-go point; however, a preliminary check is made before reaching the go, no-go point to monitor the progress of the takeoff. This check is made at the acceleration check point and is defined as the distance to the runway marker, which is 2000 feet short of the go, no-go point. This distance is established by subtracting 2000 feet from the go, no-go distance. The acceleration check speed is the minimum speed allowable at this check distance marker and is established by obtaining the speed for the distance 2000 feet short of the go, no-go distance on the Maximum or Military Thrust velocity during takeoff ground run charts and subtracting the go, no-go speed tolerance.

TAKEOFF PERFORMANCE – SAMPLE PROBLEM

Complete the takeoff portion of the Takeoff and Landing Data Card in the checklist for a Maximum Thrust takeoff with water injection. Also, determine total takeoff distance over 100 ft obstacle height and minimum afterburner blow-out speed.

Given:

Gross Weight	48,000 LB
Runway Length	8,000 FT
O.A.T.	20°C

Pressure Altitude	2,000 FT
Wind (Headwind Component)	10 KN
Runway Gradient	None
R.C.R.	23

Solution:

1. Enter Sample Takeoff Speed Chart (page B2-4) at a gross weight of 48,000 lb, (A); follow a vertical path upward to (B) and (C) then move directly across to (D) and (E) and read rotation speed and takeoff speed (178 KCAS and 188 KCAS), respectively.

Note

The method for reading the velocity at obstacle height (climb-out speed) is the same as shown in step 1.

2. Enter Sample Takeoff Index Chart (page B2-4) at outside air temperature 20°C, (F); move vertically to the 2000 ft pressure altitude, (G); move horizontally to the Maximum Thrust with water injection line, (H); drop down to Takeoff Index Scale and read Takeoff Index = 9.55 (J).
3. Enter Sample Climb-Out Index Chart (page B2-4) at outside air temperature = 20°C, (AA); move vertically to the 2000 ft pressure altitude, (BB); move horizontally to the maximum thrust with water injection line (CC); drop down to Climb-Out Index Scale and read Climb-Out Index = 9.75, (DD).
4. Enter Sample Takeoff Ground Run Chart (page B2-6) at Takeoff Index (step 2 = 9.55, (K); move horizontally to takeoff gross weight = 48,000 lb, (L); move vertically downward until the zero wind condition is reached at (M) and read ground run (no wind) = 5150 ft. From (M) parallel the guide lines until a 10 knot headwind line is reached at (N), and proceed vertically to the zero % grade at (O). From (O) move vertically downward to the Ground Run Scale and read ground run distance = 4650 ft, (P).

Note

SAMPLE PROBLEM INITIAL CONDITIONS STATE NO RUNWAY SLOPE.

However, if a correction for runway slope is required proceed as follows: For a 2% downhill slope, correct the ground run distance by continuing from (O) (step 4) parallel to the downhill guide lines until the 2% condition is reached at (Q) and proceed vertically downward to the Ground Run Scale to read the corrected ground run = 4400 ft, (R).

5. Enter Sample Air Distance Chart (page B2-6) at Climb-Out Index (step 3) = 9.75, (EE); move horizontally to takeoff gross weight = 48,000 lb, (FF) and move vertically downward to base line, (GG). From (GG) parallel the guide lines until a 100 ft obstacle height is reached at (HH). From (HH) proceed vertically to the zero-wind condition at (JJ) and parallel the guide lines until a 10 knot headwind is reached at (KK). From (KK) proceed vertically to the Air Distance Scale and read air distance = 2500 ft, (LL). Total takeoff distance = ground run plus air distance = 4650 + 2500 = 7250 ft.

Note

Assume drag chute deployed.

6. Enter Sample Refusal Speed Chart (page B2-7) at Takeoff Index (step 2) = 9.55 at A' and move across to runway length available = 8000 ft, (B'). From B' drop vertically to the curve marked "With Drag Chute" stopping at takeoff gross weight = 48,000 lb, (C') move across to intercept RCR = 23 at (D') and drop down to the scale to read refusal speed = 174 KCAS (E') for zero-wind condition. Add 10 knots to zero-wind refusal speed to adjust for headwind condition; (147 + 10) = 157 KCAS.
7. Enter Sample Minimum Afterburner Blow-Out Speed Chart (page B2-7) at Takeoff Index (step 2) = 9.55, (T) move across to the runway length available at 8000 ft, (U), drop down to the takeoff gross weight of 48,000 lb, (V) move across stopping at the zero-wind condition at (W) and follow parallel to the headwind guide line until the 10 knot wind is reached at (X). Proceed horizontally to the scale and read afterburner blow-out speed = 169 knots, (Y).

Note

Takeoff may therefore be safely aborted at any time before 157 KCAS (refusal speed)

is reached. If the afterburner should fail between 157 KCAS and 169 KCAS prepare to engage the barrier. If the afterburner should fail after 169 KCAS has been attained, takeoff can be completed with Military Thrust.

8. Enter Sample Velocity During Ground Run Chart (page B2-6) at Takeoff Speed (step 1) = 188 KCAS and ground run (no wind, step 4 - M) distance = 5150 ft at (Q). Parallel the the guide line to intersect the zero-wind refusal speed, 147 KCAS, and read refusal distance = 3050 ft. at (R). Go, no-go distance is therefore 3000 ft and acceleration check distance = $3000 - 2000 = 1000$ ft. Continue to parallel guide line from (R) to read zero-wind normal speed at the go, no-go marker = 146 KCAS at (S) and zero-wind normal speed at the acceleration check marker = 86 KCAS at (S'); or $(146 + 10) = 156$ KCAS and $(86 + 10) = 96$ KCAS respectively, with wind.
9. To determine go, no-go tolerance, compute 90% of runway length $(0.9 \times 8000) = 7200$ ft. Reenter velocity during ground run curve at takeoff speed = 188 KCAS and distance = 7200 ft (Q'), and parallel guide line until the go, no-go distance (3000 ft) is intersected

at (R') and read zero-wind speed = 126 KCAS. Thus, the maximum speed deficiency that is acceptable at the go, no-go distance is $(146 - 126) = 20$ KCAS.

10. Compute Go, No-Go Speed. $156 - 20 = 136$ KCAS.

Compute Acceleration Check Speed $96 - 20 = 76$ KCAS.

11. Fill out Takeoff Data Card and summarize additional data.

Acceleration Check . . . 76 K at 1000 FT
(Marker No. 7)

Rotation Speed 178 K

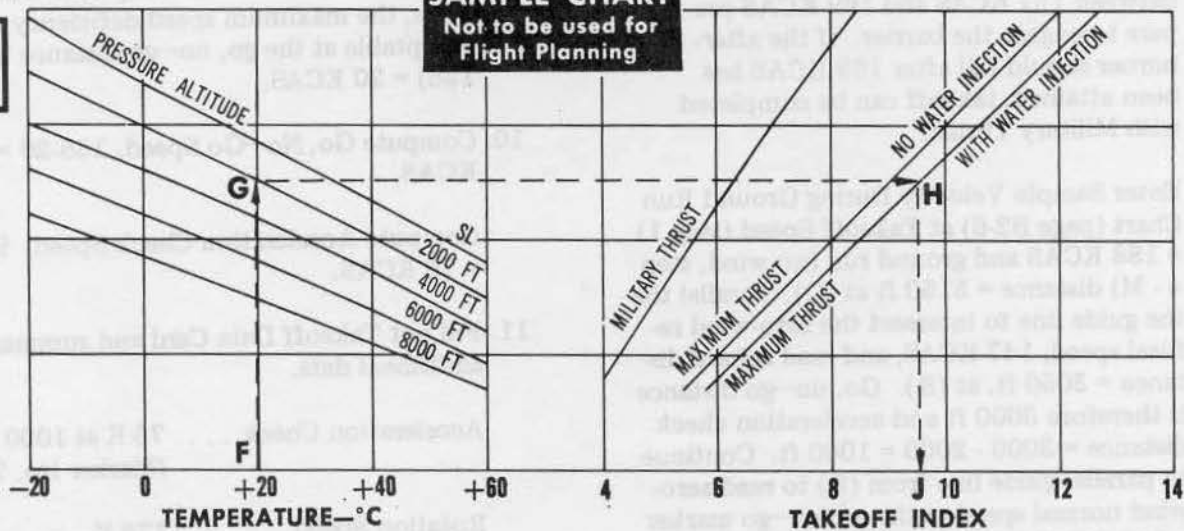
Go, No-Go Check . . . 136 K at 3000 FT
(Marker No. 5)

Refusal Speed 157 K

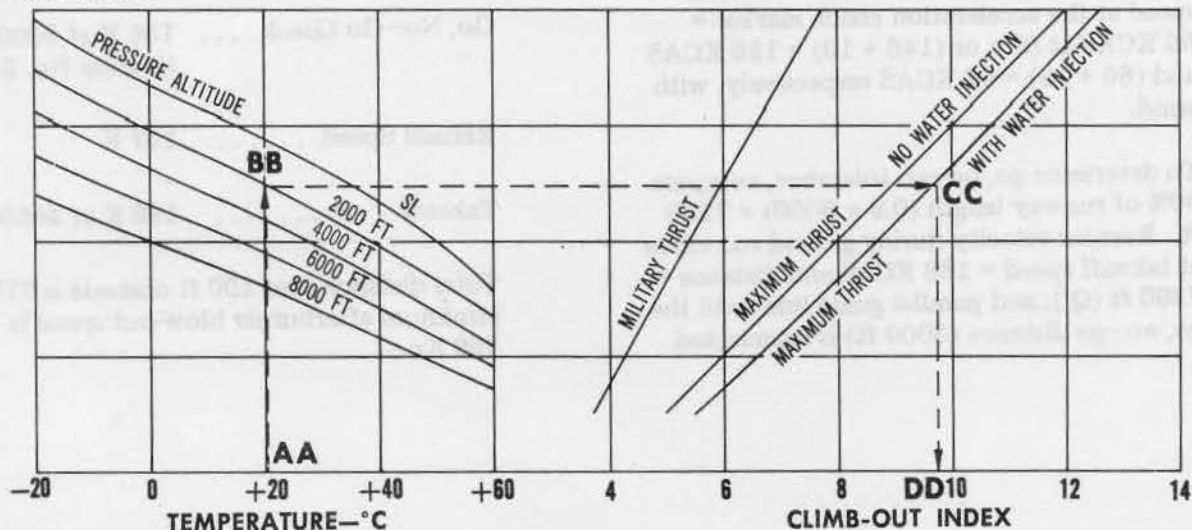
Takeoff 188 K at 4650 FT

Total distance over 100 ft obstacle is 7150 ft.
Minimum afterburner blow-out speed is 169 Kn.

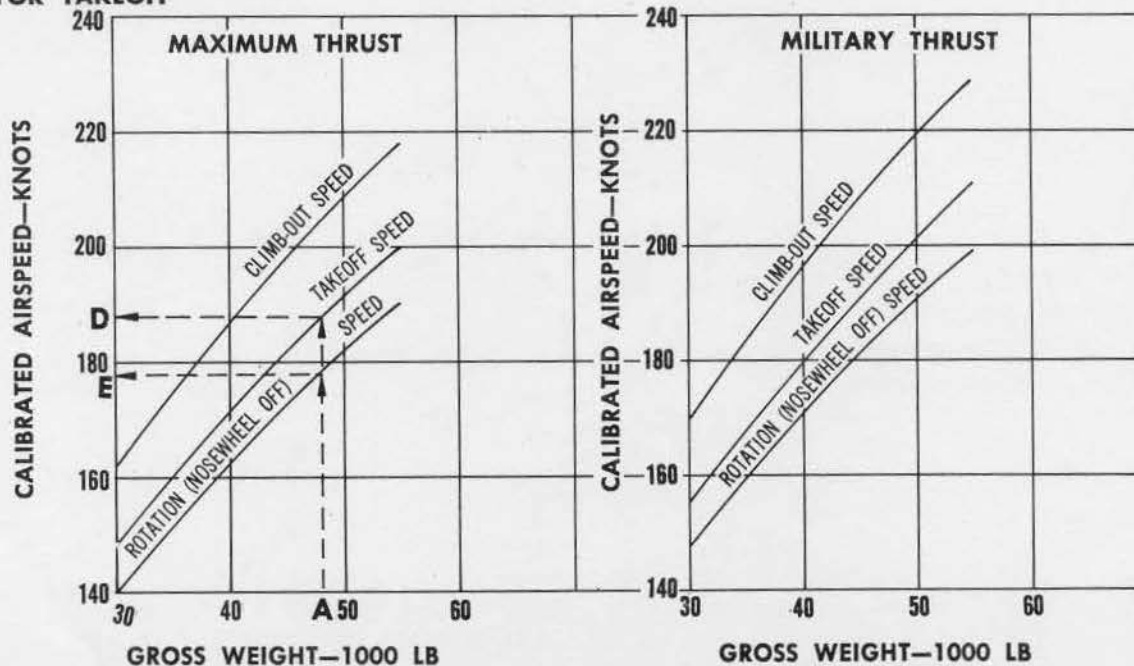
TAKEOFF INDEX

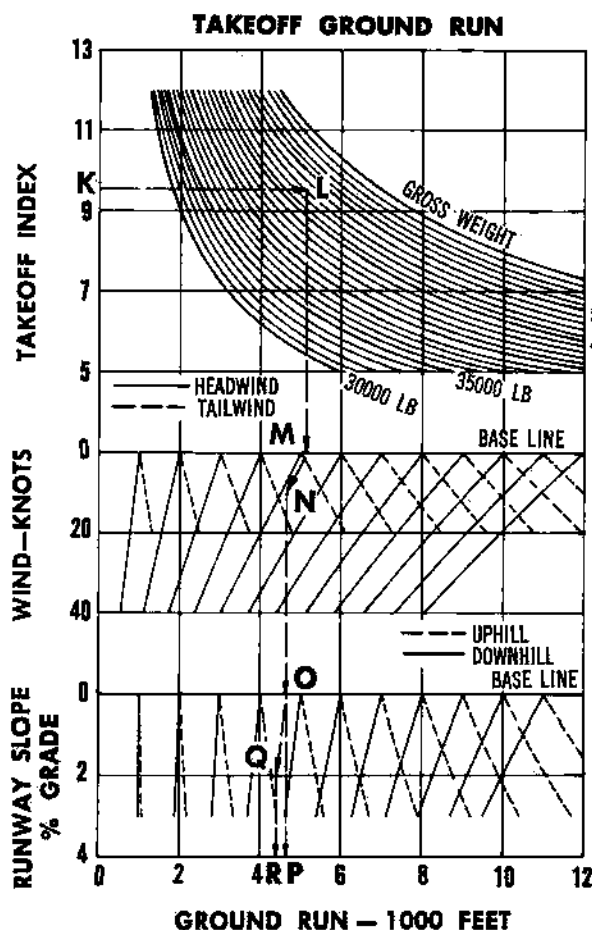
F**SAMPLE CHART**Not to be used for
Flight Planning

CLIMB-OUT INDEX

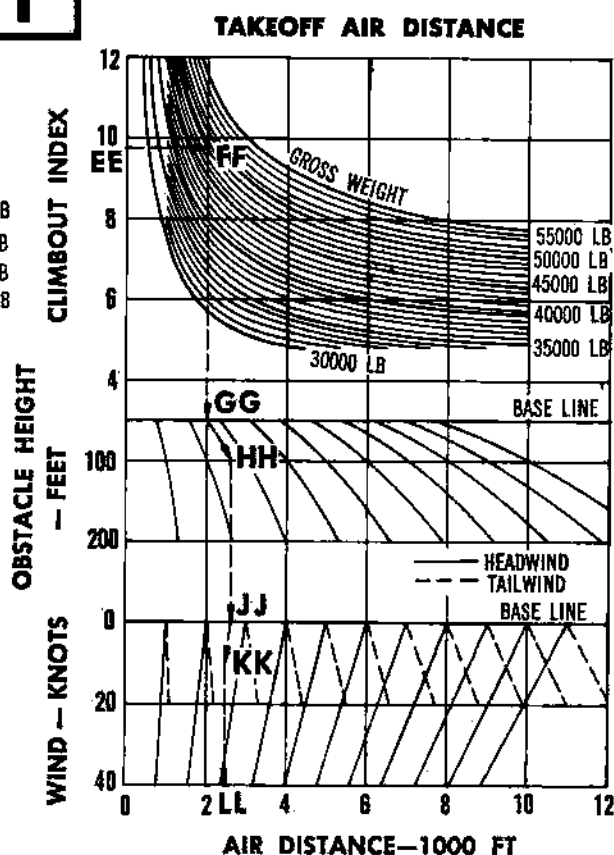


SPEEDS FOR TAKEOFF

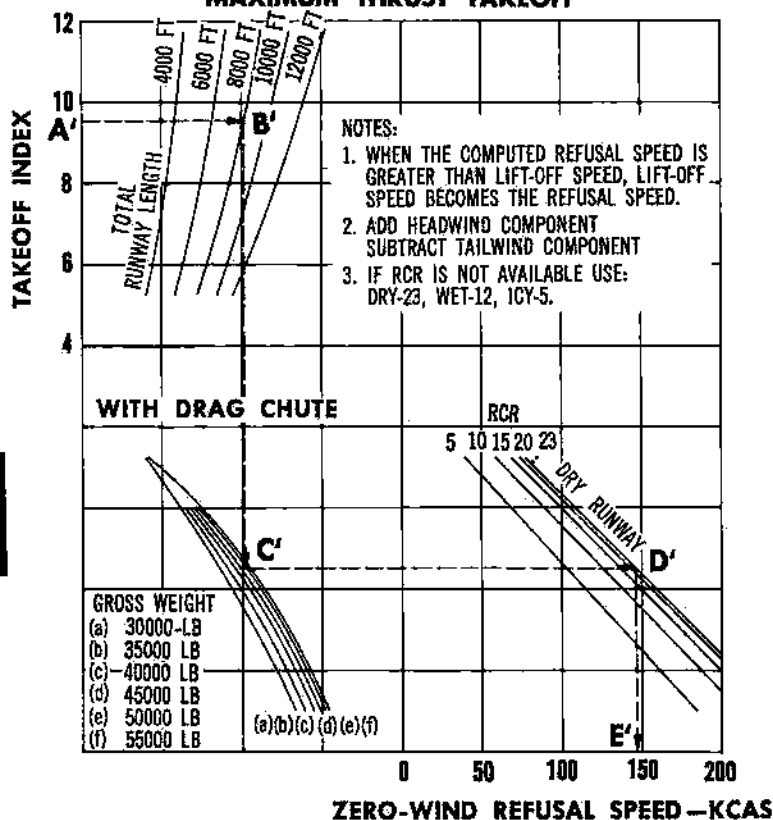




F

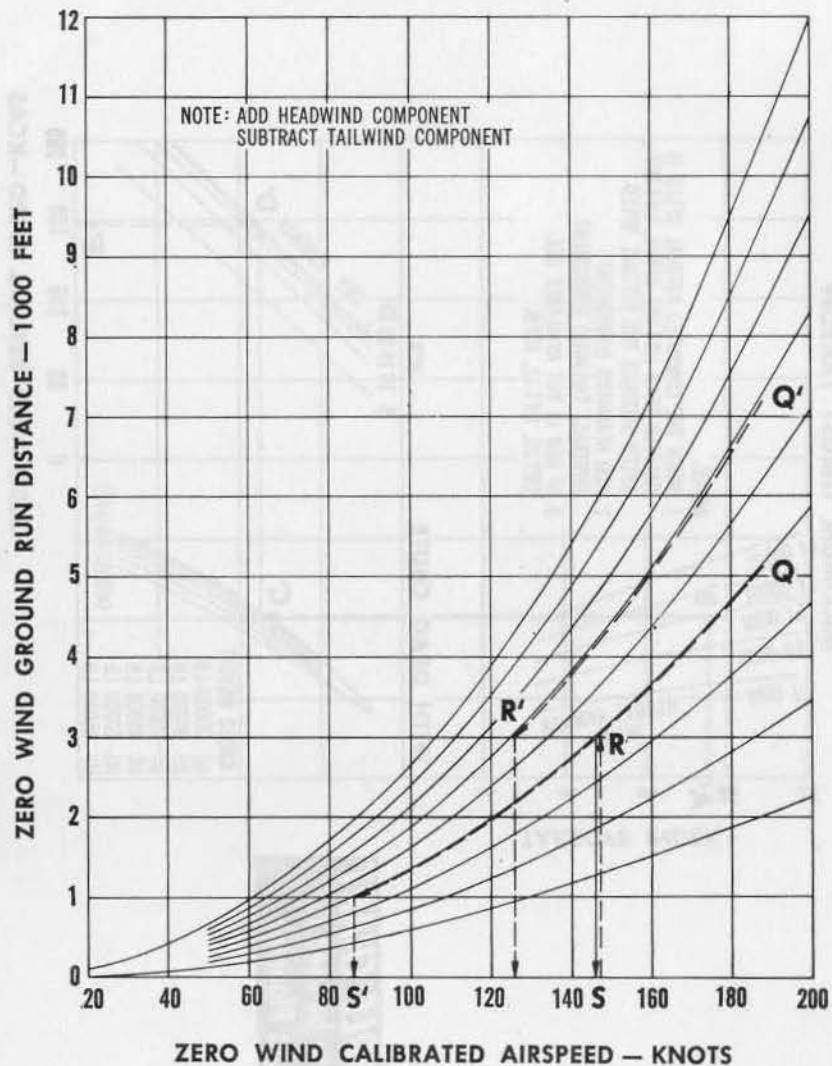


**REFUSAL SPEED
MAXIMUM THRUST TAKEOFF**

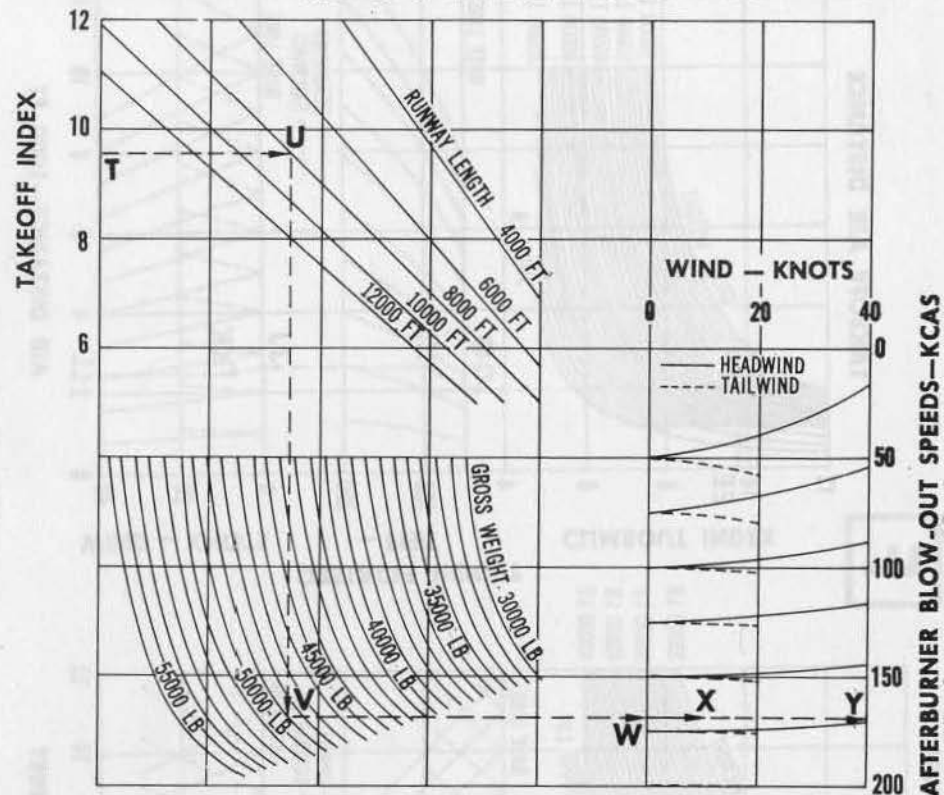


SAMPLE CHART
Not to be used for
Flight Planning

VELOCITY DURING TAKEOFF GROUND RUN



MINIMUM AFTERBURNER BLOW-OUT SPEEDS



NOTE:
IF AFTERBURNER FAILS BELOW MINI-
MUM AFTERBURNER BLOW-OUT SPEED
AND ABOVE MAXIMUM REFUSAL SPEED,
PREPARE TO ENGAGE BARRIER.

THROTTLE INBOARD IMMEDIATELY
AFTER AFTERBURNER FAILURE

SAMPLE CHART
Not to be used for Flight Planning



TAKEOFF
LE FLAPS — 100%
TE FLAPS — 100%

F

model: F-105F fuel density: 6.5 LB/GAL
 engine: J75-P-19W data date: 1 JULY 1964
 fuel grade: JP-4 data basis: FLIGHT TEST

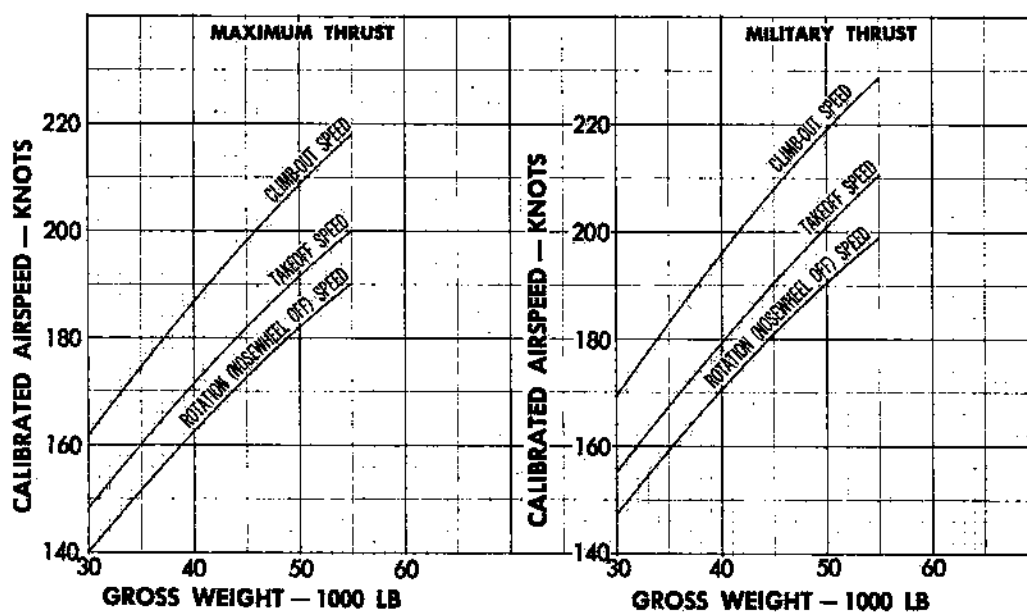
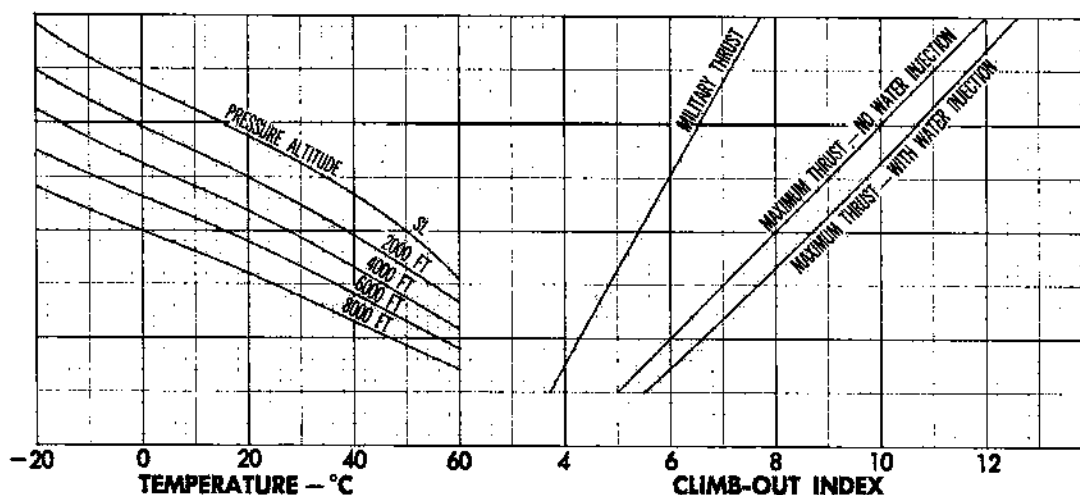
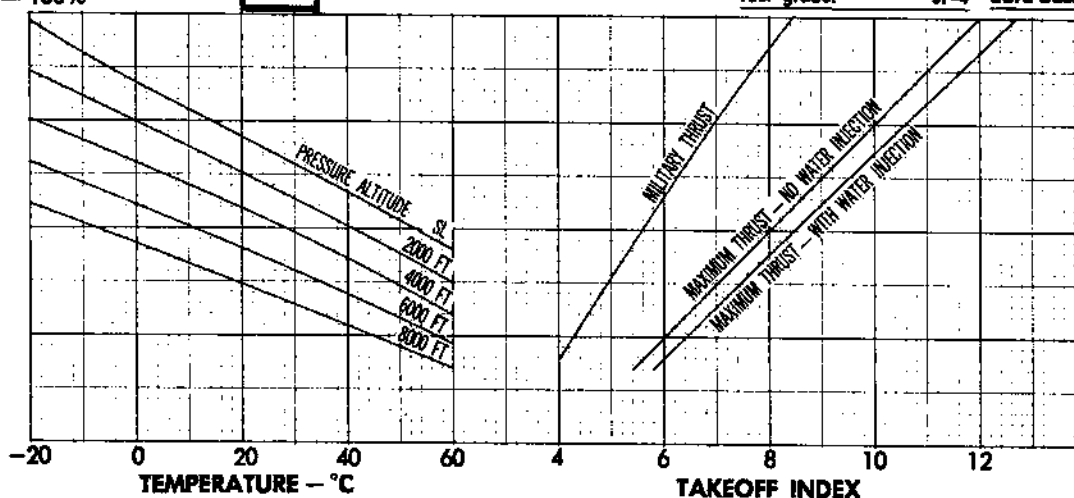


Figure B2-1

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

F

TAKEOFF GROUND RUN
HARD SURFACE RUNWAY
LE FLAPS - 100%, TE FLAPS - 100%

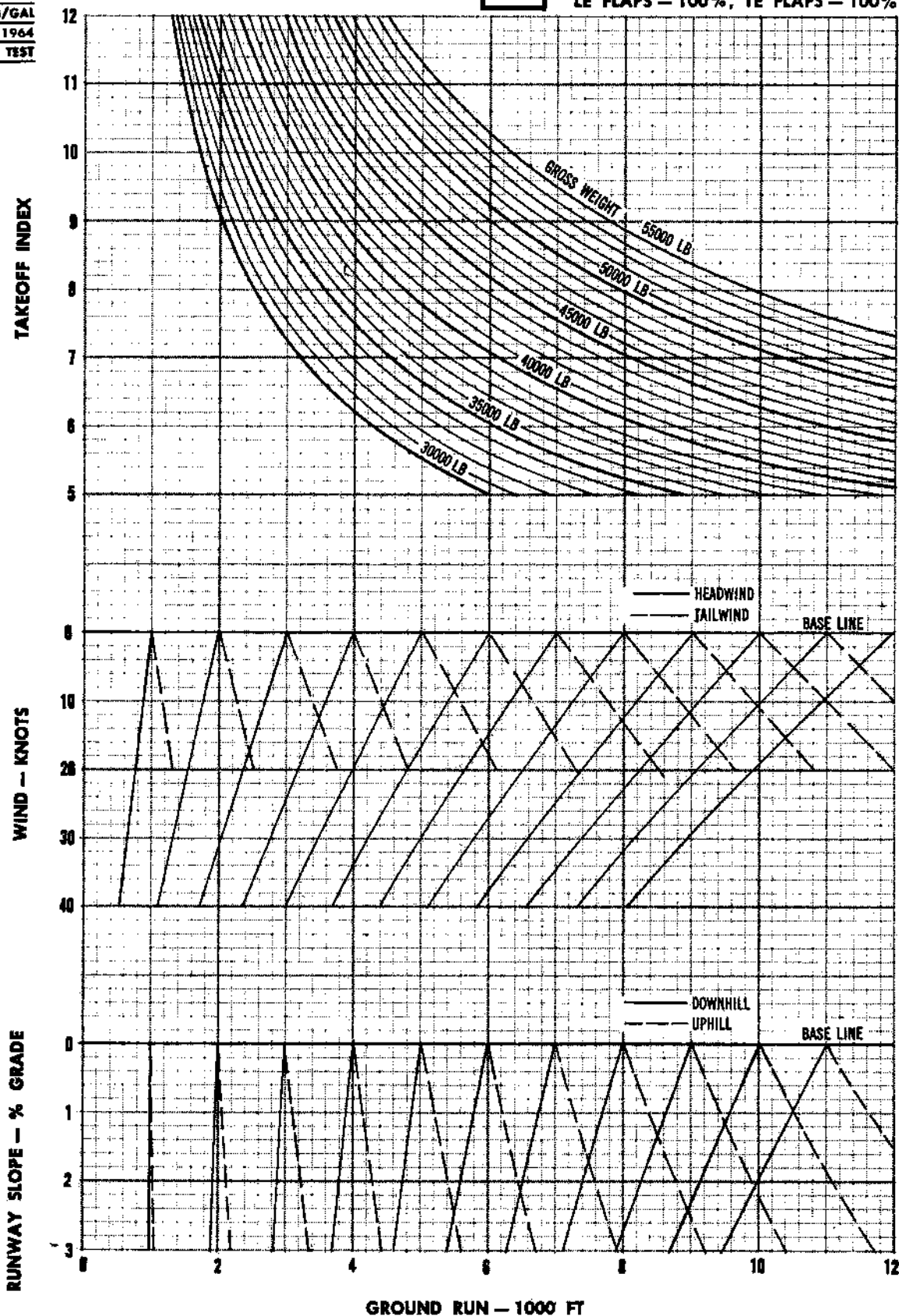


Figure B2-2

TAKEOFF AIR DISTANCE

LE FLAPS — 100%,

TE FLAPS — 100%

F

model: F-105F

engine: J75-P-19W

fuel grade: JP-4

fuel density: 6.5 LB/GAL

data date: 1 JULY 1964

data basis: FLIGHT TEST

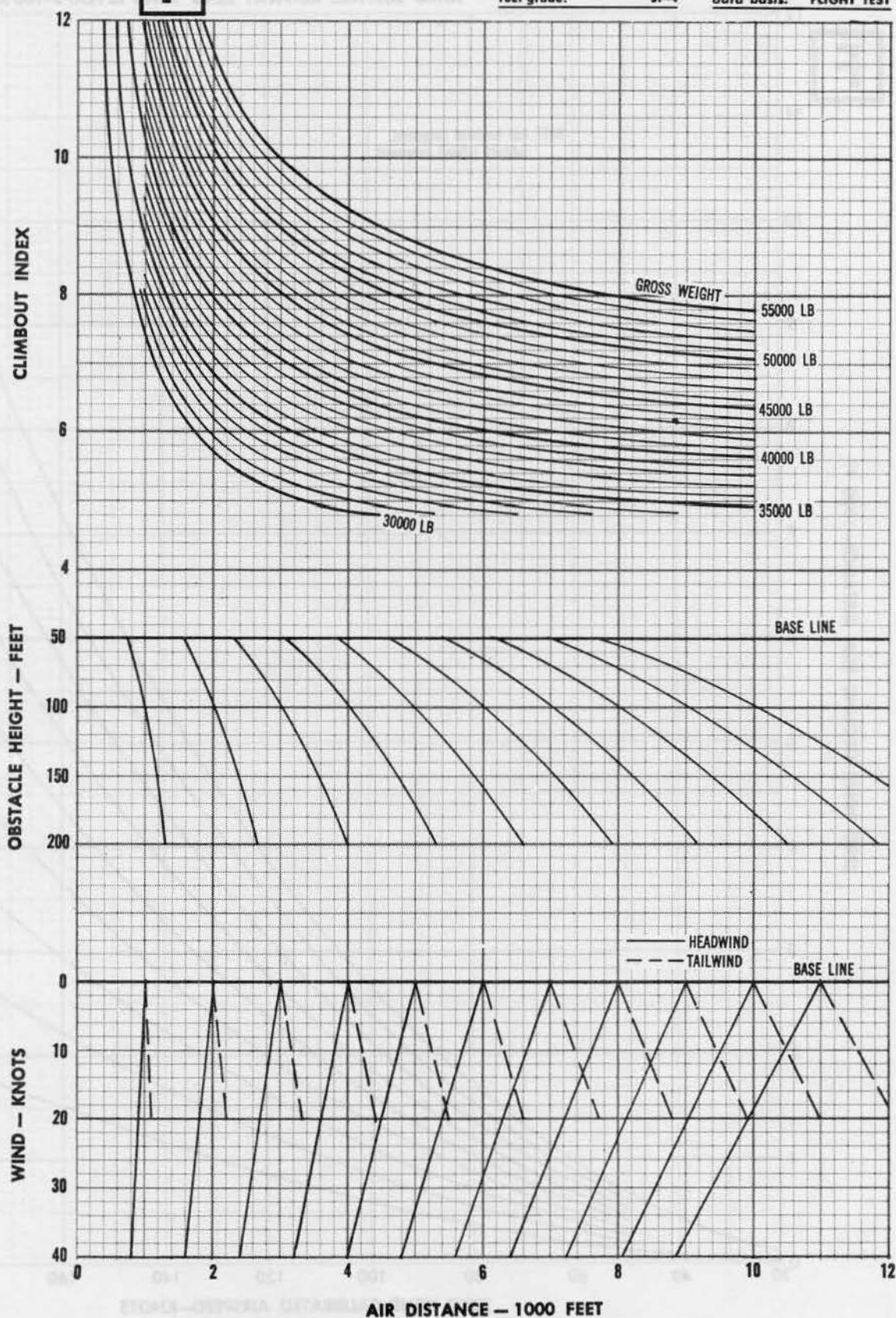


Figure B2-3

model: F-105F fuel density: 6.5 LB/GAL
engine: J75-P-19W data date: 1 JULY 1964
fuel grade: JP-4 data basis: FLIGHT TEST

VELOCITY DURING TAKEOFF GROUND RUN
MAXIMUM THRUST (WITH OR WITHOUT WATER INJECTION)
HARD SURFACE RUNWAY ZERO WIND LE FLAPS-100%; TE FLAPS-100%

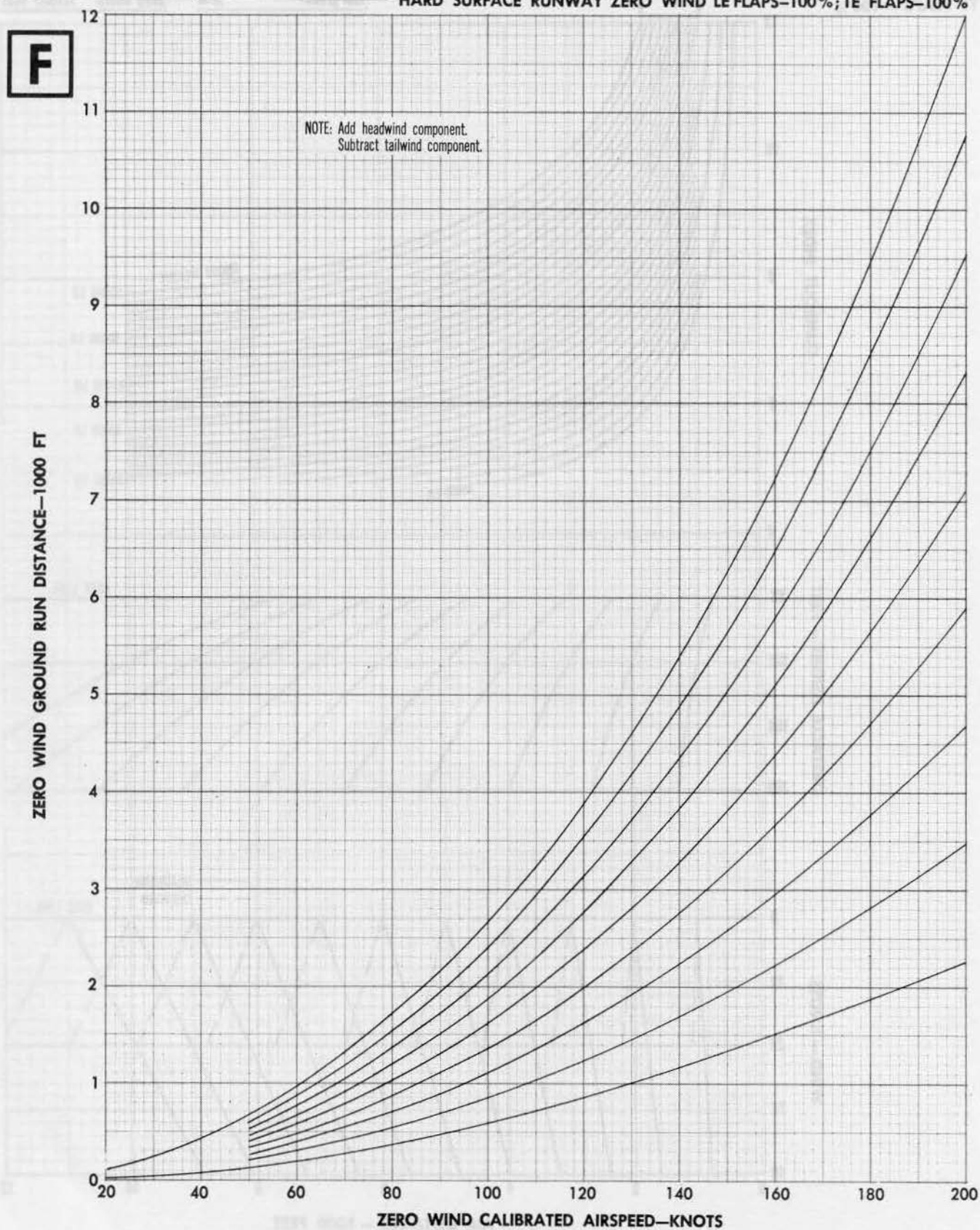


Figure B2-4

VELOCITY DURING TAKEOFF GROUND RUN**MILITARY THRUST****HARD SURFACE RUNWAY, ZERO WIND, LE FLAPS—100%; TE FLAPS—100%**

model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST

F

ZERO WIND GROUND RUN DISTANCE—1000 FT

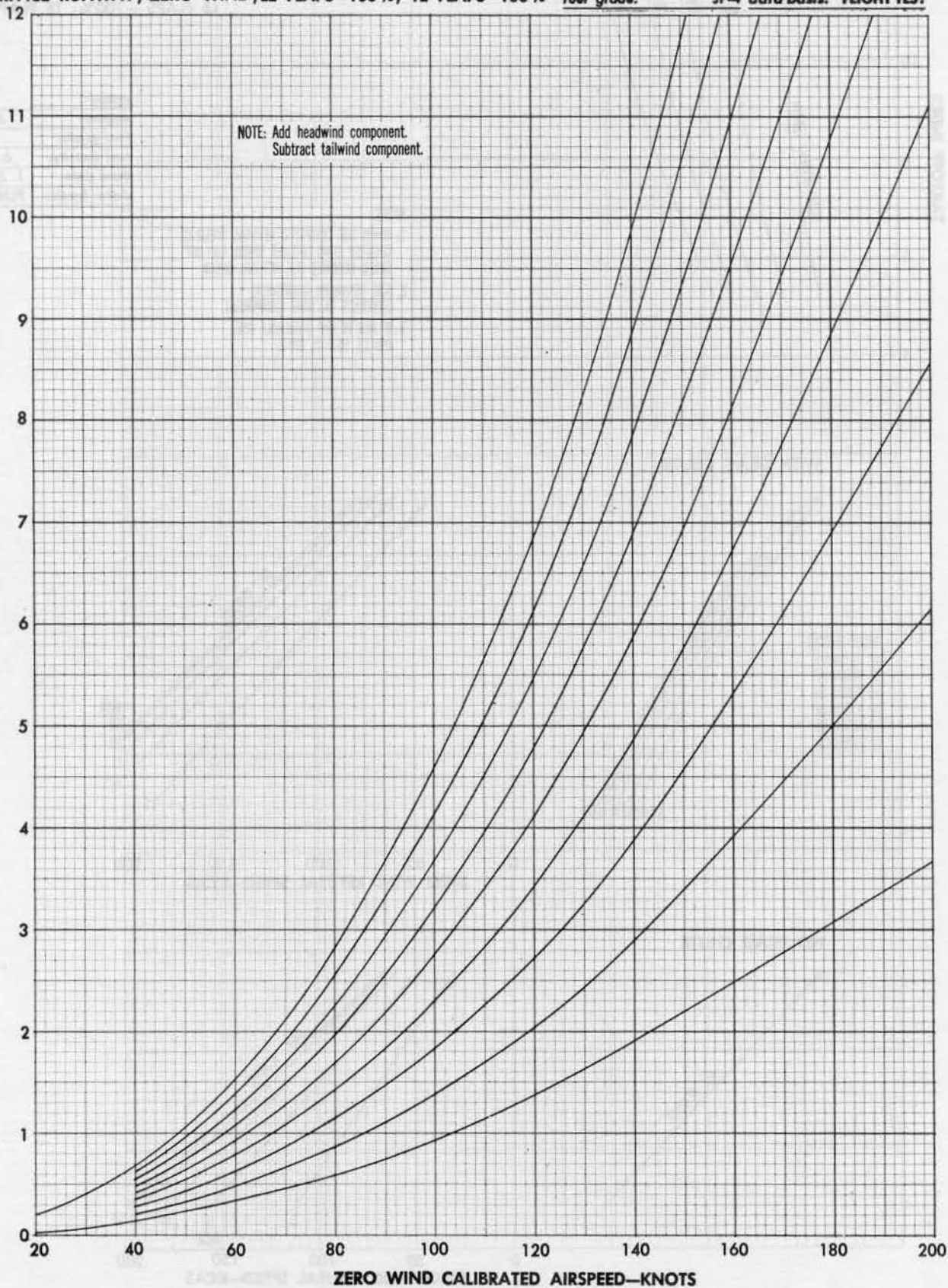


Figure B2-5

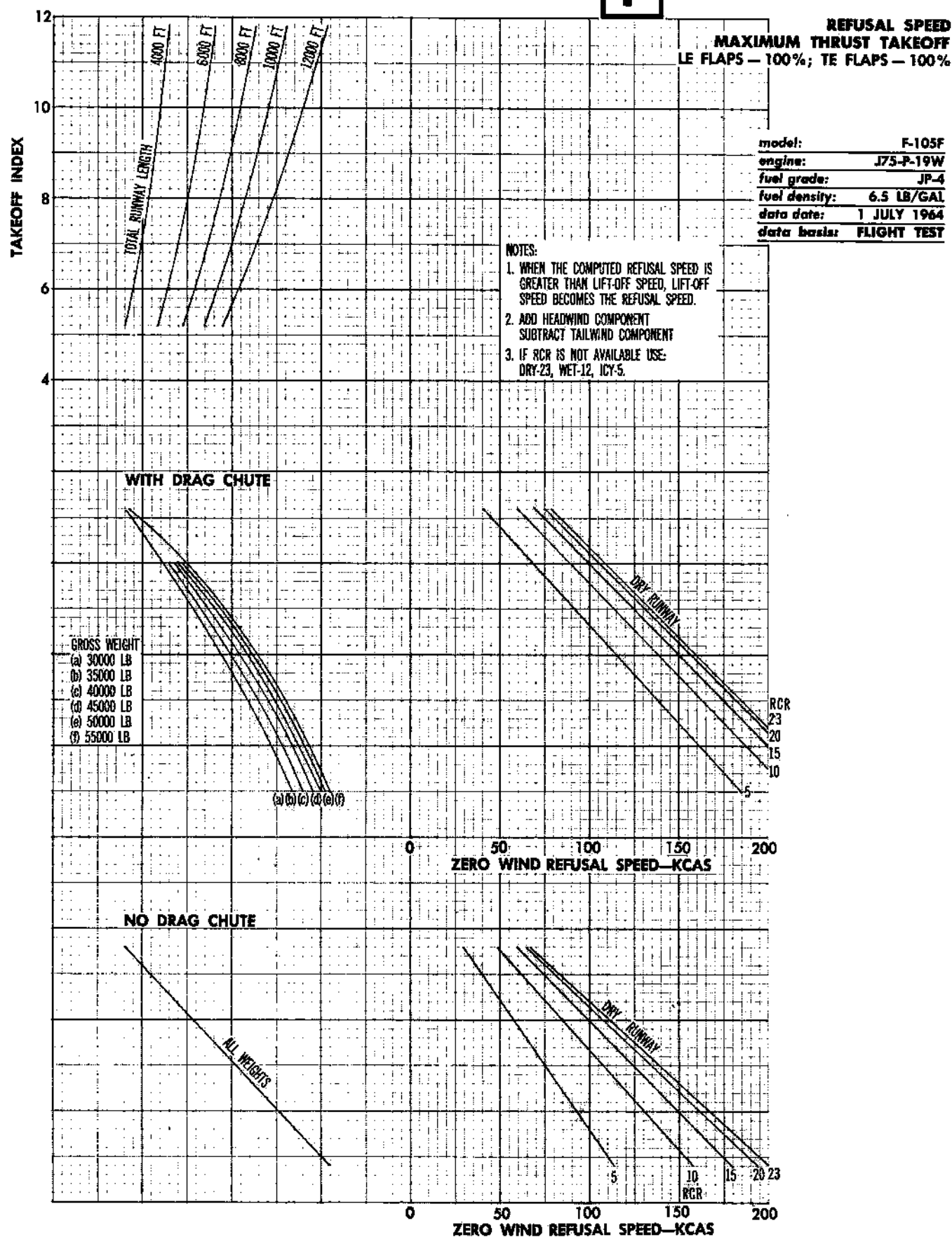
F

Figure B2-6

REFUSAL SPEED
MILITARY THRUST TAKEOFF
 LE FLAPS — 100%;
 TE FLAPS — 100%



model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

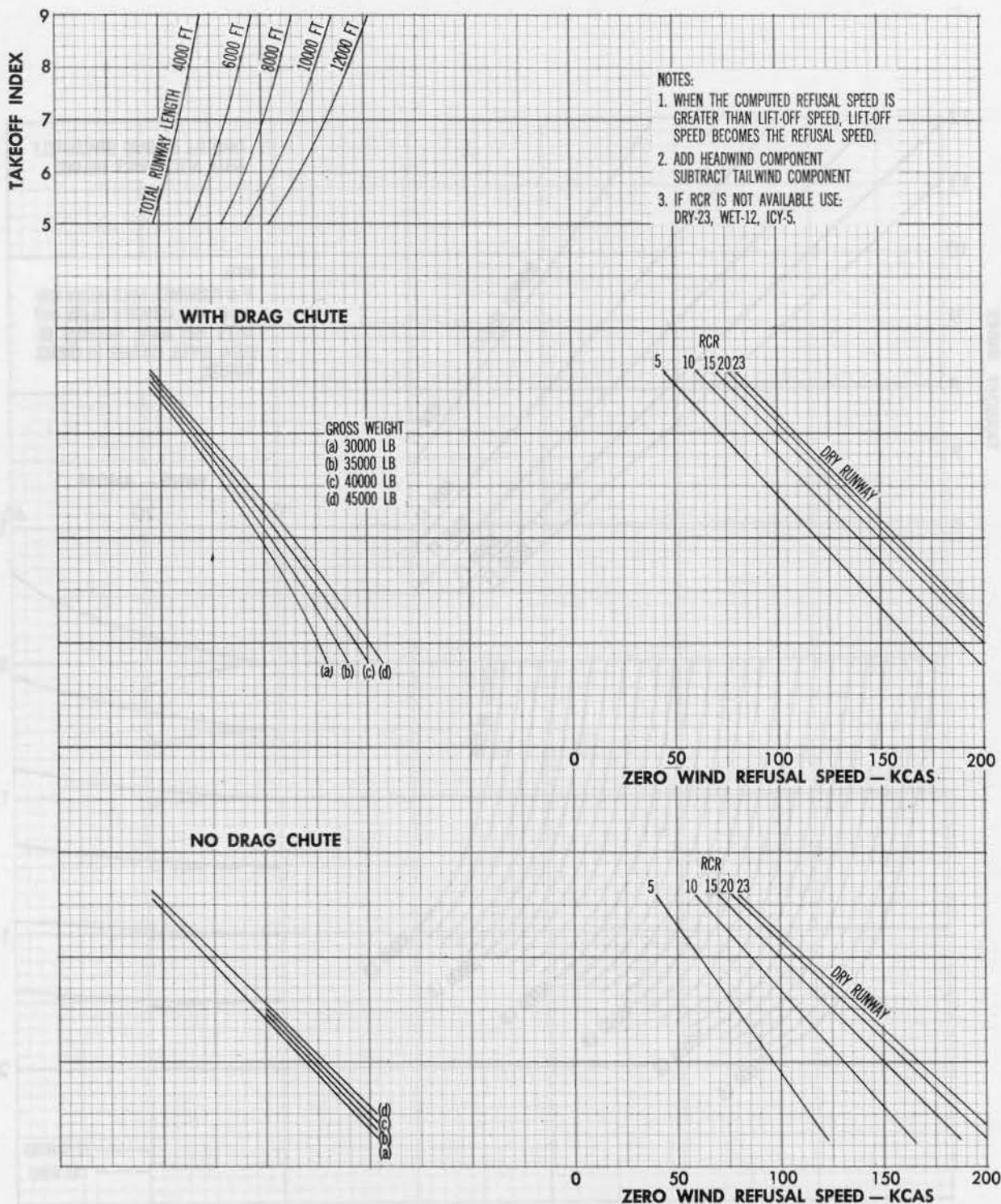


Figure B2-7

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST



MINIMUM AFTERBURNER BLOW-OUT SPEEDS

LE FLAPS — 100%; TE FLAPS — 100%
 HARD SURFACE RUNWAY

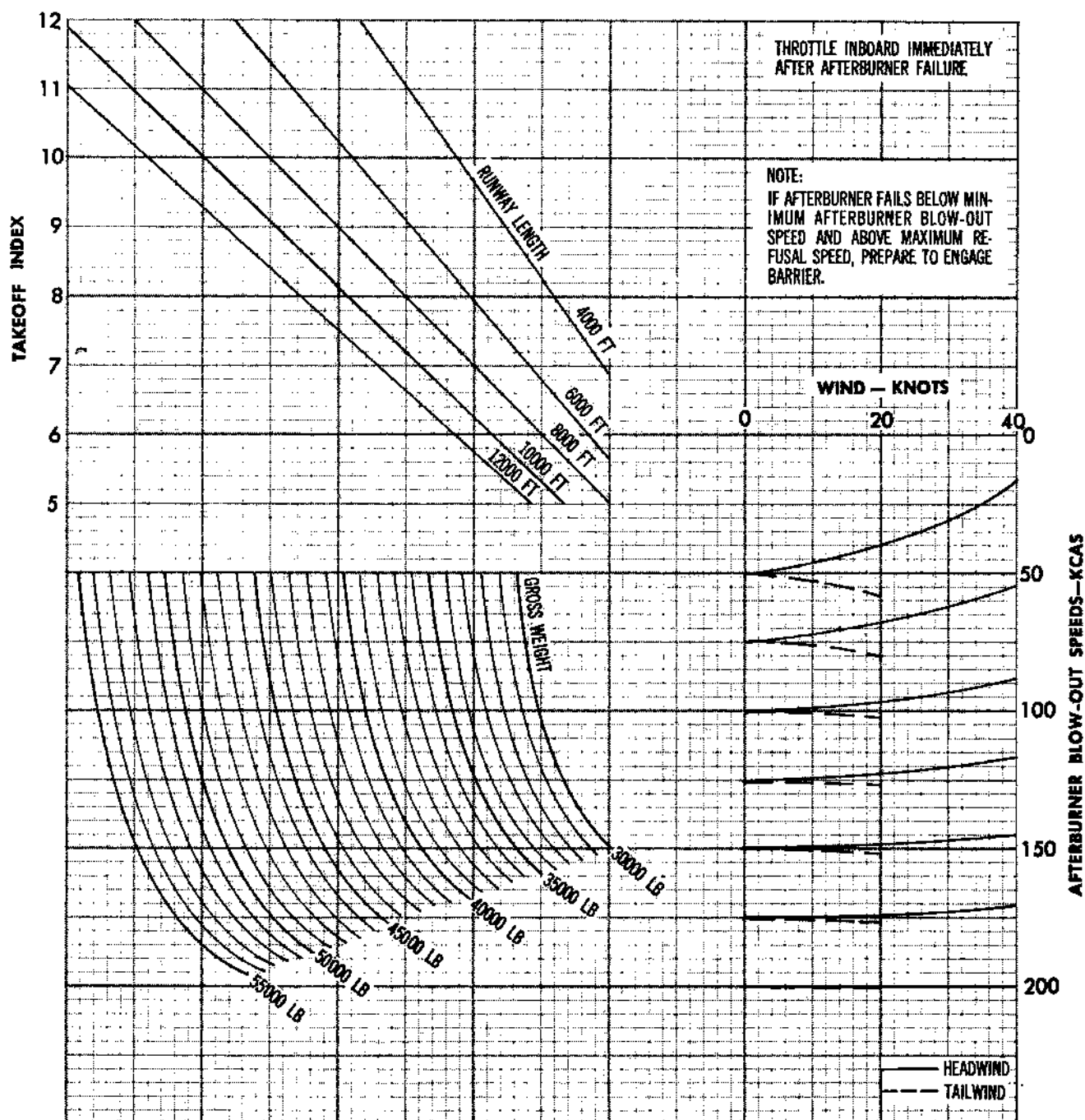
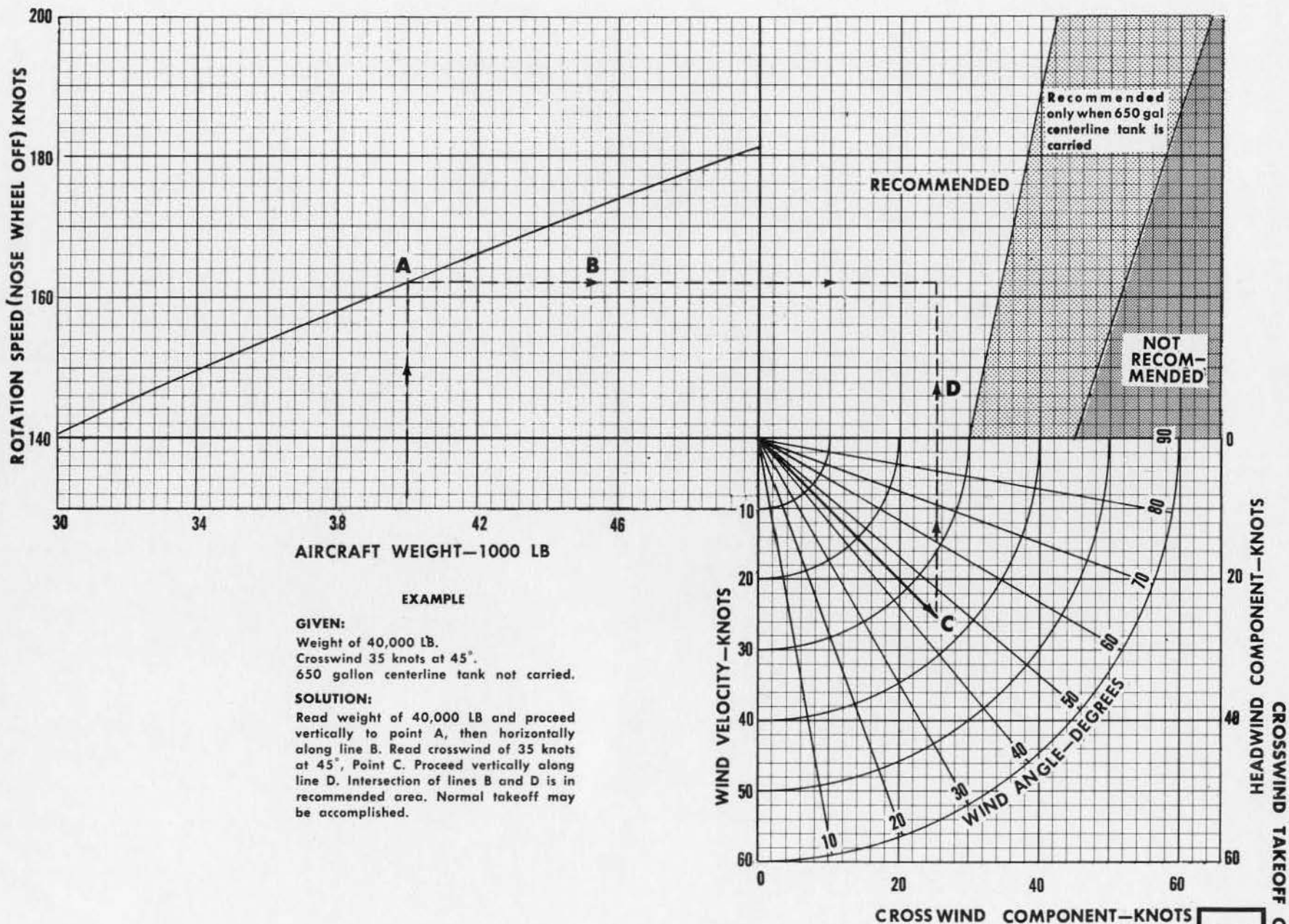


Figure B2-8

Figure B2-9



PART 3 CLIMB**TABLE OF CONTENTS**

	Page
Climb Information	B3-1
Sample Problem	B3-2, B3-4
Fuel, Time and Distance from Brake Release to Climb Speed	B3-8
Maximum Thrust Climb — Constant Mach Number	B3-9
Maximum Thrust Climb — Speed Schedule 400 KCAS to Recommended Mach No.	B3-11
Military Thrust Climb — Speed Schedule 400 KCAS to Recommended Mach No.	B3-13
Military Combat Ceiling	B3-14
Maximum Combat Ceiling	B3-15
Optimum Cruise Altitude	B3-15
Military Thrust Climb — DC135/F105 Buddy Speed Schedule	B3-16

CLIMB INFORMATION

Charts in this part enable the pilot to determine the fuel, time and distance to climb between any two altitudes, with either Maximum or Military Thrust setting. Both thrust settings are shown for a speed schedule of 400 KCAS to the Recommended Mach Number, and, for Maximum Thrust, at constant Recommended Mach Number.

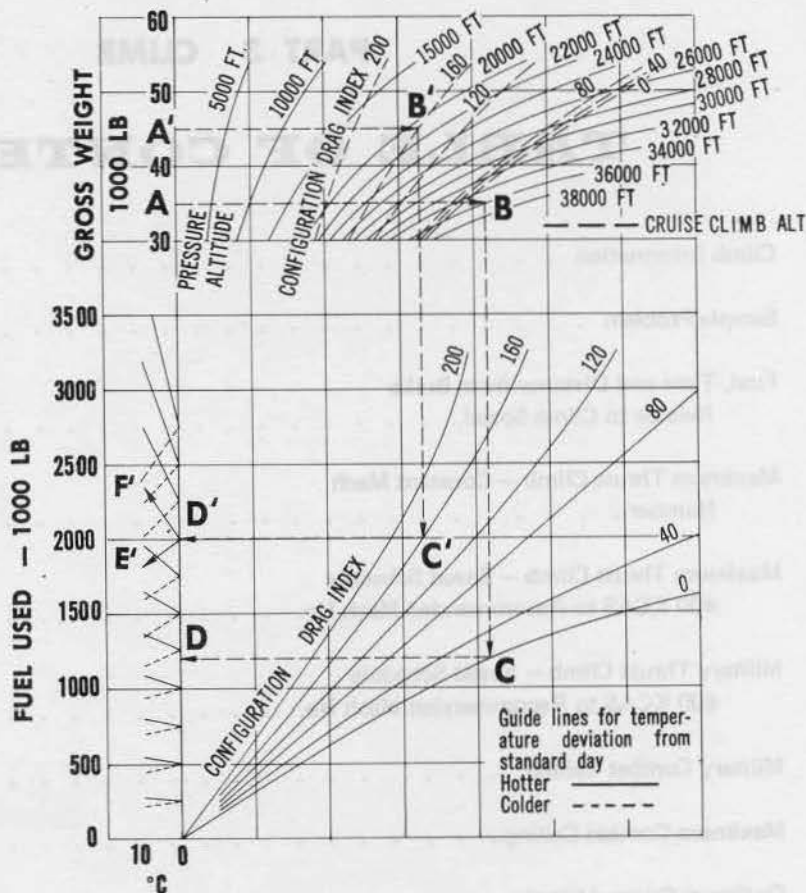
In addition, Military Thrust climb charts are shown for the recommended KC-135/F105 Buddy Climb Speed schedule, 325 KCAS.

Fuel, time and distance from brake release to 400 KCAS are also presented for both Military and Maximum Thrust takeoff.

MILITARY THRUST CLIMB
400 KCAS TO RECOMMENDED MACH NO.



SAMPLE CHART
Not to be used for
Flight Planning



EXAMPLE I.

Conditions: Configuration: Clean

Initial Gross Weight: 35,000 lb

Initial Altitude: Sea Level

Final Altitude: 36,000 ft.

Climb Thrust Setting: Military

Ambient Temperature: Standard Day

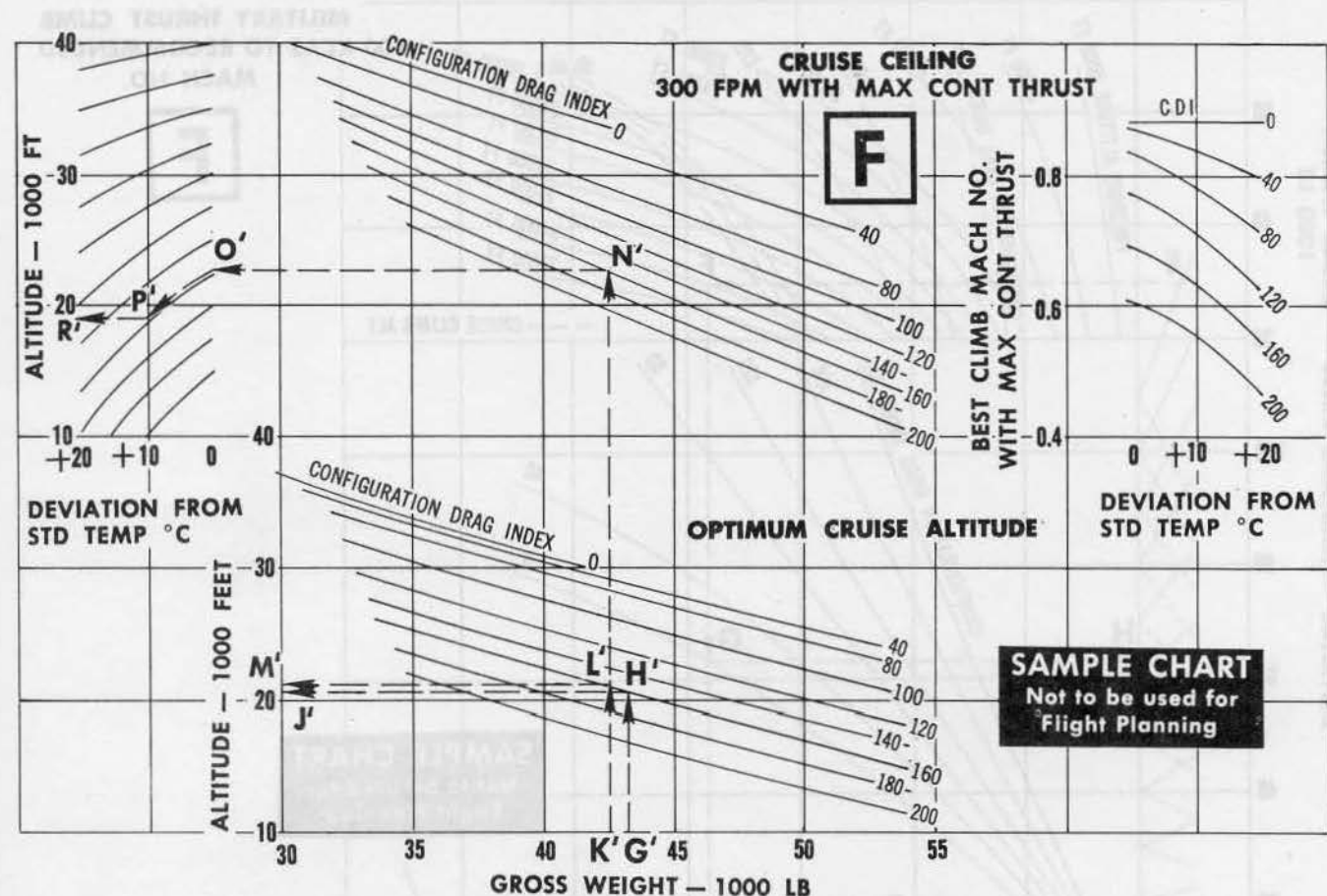
Find: Fuel, Distance and Time to climb, and
climb speeds.

Solution:

1. Enter sample chart page B3-2 at a gross weight of 35,000 lb, (A).
2. Move to the right to the final altitude of 36,000 ft, (B).
3. Drop down to Configuration Drag Index = 0, (C).

4. Move to the left to the Standard Day Condition (0°C temperature deviation) and read fuel used to climb, 1200 lbs, (D).
5. To find distance covered and time elapsed enter sample chart (page B3-3 at initial gross weight, 35,000 lb, (E).
6. Move to the right to the final altitude, 36,000 ft, (F).
7. Drop down to the distance chart, stopping at Configuration Drag Index = 0, (G).
8. Move to the left to Standard Day Condition (0°C temperature deviation) and read distance covered in climb, 63 NMi. (H).
9. From G continue down to the time chart, stopping at Configuration Drag Index = 0, (J).
10. Move to the right to Standard Day Condition (0°C temperature deviation) and read time elapsed in climb, 7.8 min, (K).
11. Enter Mach Number table on Figure B3-4 for clean aircraft (Configuration Drag Index 0 - 40) and read the recommended climb Mach number and calibrated airspeed at each altitude.





EXAMPLE II.

Conditions: Configuration: Clean + (6) centerline M-117 750 lb bombs + (8) M-117 750 lb bombs inboard + (2) special outboard pylons and adapters for AIM-9B Sidewinder missiles.

Initial Gross Weight: 45,000 lb

Initial Altitude: Sea Level

Final Altitude: Optimum Cruise (cruise-climb altitude)

Climb Thrust Setting: Military

Ambient Temperature: At altitude, average temperature deviation is

A. 10°C colder than Standard Day

B. 10°C hotter than Standard Day

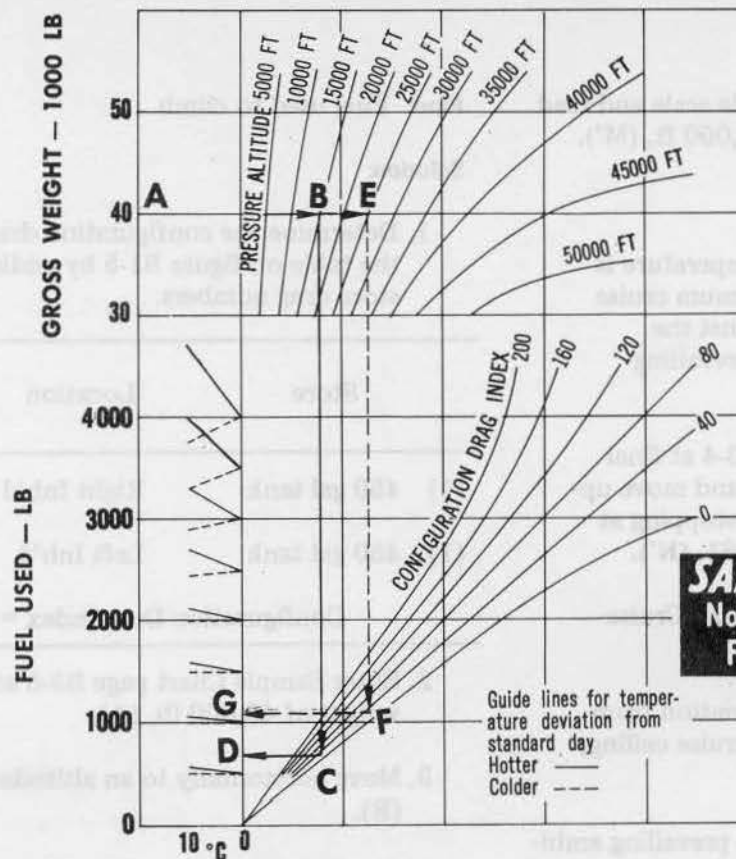
Find: Fuel used to climb, level-off altitude and climb speeds.

A. Ambient Temperature Colder than Standard Day

1. Determine the configuration drag index from the table on figure B1-5 by adding the various store drag numbers.

Store	Location	Store Drag NO.
(6) M-117 750 lb Bombs	Centerline	75
(4) M-117 750 lb Bombs	Right Inb'd	40
(4) M-117 750 lb Bombs	Left Inb'd	40
(1) Special Pylon & Adapter for AIM-9B Missile	Right Outb'd	3
(1) Special Pylon Adapter for AIM-9B Missile	Left Outb'd	3

Configuration Drag Index = 161



MAXIMUM THRUST CLIMB CONSTANT MACH NUMBER

F

SAMPLE CHART
Not to be used for
Flight Planning

2. Enter sample chart page B3-2 at a gross weight of 45,000 lb, (A').
 3. Move to the right to cruise-climb altitude for Configuration Drag Index = 161, (B').
 4. Drop down to Configuration Drag Index = 161, (C').
 5. Move to the left to the Standard Day Condition (0°C temperature deviation), D'.
 6. Follow the "colder" day guide line to a temperature deviation of 10°C and read fuel used to climb, 1825 lb, (E').
 7. To find the level-off altitude, compute gross weight at end of climb. Initial gross weight (45,000 lb) - Fuel used to climb (1825 lb) = weight at end of climb (43,175 lb).
 8. Enter sample chart (optimum cruise altitude) on page B3-4 at final gross weight, 43,175 lb at G'.
 9. Move up to Configuration Drag Index = 161, (H').
 10. Move to the left to the altitude scale and read optimum cruise altitude, 20,500 ft, (J'). On a standard or cold day, level-off altitude for cruise-climb is this optimum cruise altitude.
 11. Enter the Mach number table on figure B3-4 for a Configuration Drag Index = 161 (between 160-180) and read the recommended climb Mach Number and calibrated airspeed at each altitude.
 12. Distance covered and time elapsed in climb can be read from page B3-3 using the same method as described in Example I.
- B. Ambient Temperature Hotter than Standard Day.**
- (1) thru (5) same as A, above.
 6. Follow the "hotter" day guide line to a temperature deviation of 10°C and read fuel used to climb, 2350 lb, F'.
 7. To find the level off altitude, compute gross weight at end of climb (45,000 lb - 2350 lb = 42,650 lb).
 8. Enter sample chart (optimum cruise altitude) on page B3-4 at final gross weight, 42,650 lb, (K').
 9. Move up to Configuration Drag Index = 161, (L').

10. Move to the left to the altitude scale and read Optimum Cruise Altitude, 21,000 ft, (M').

Note

Since the average ambient temperature is above Standard Day, the optimum cruise altitude must be checked against the cruise ceiling altitude at the prevailing ambient temperature.

11. Re-enter sample chart page B3-4 at final gross weight, 42,650 lb at K' and move upward to Cruise Ceiling Chart, stopping at Configuration Drag Index = 161, (N').
12. Move to the left to Standard Day Cruise Ceiling 22,600 ft, (O').
13. Follow guide line to 10°C deviation from Standard Day at P' and read cruise ceiling, 19,000 ft (R').
14. Since the Cruise ceiling at the prevailing ambient temperature (19,000 ft) is lower than Optimum Cruise altitude (21,000 ft), level-off altitude must be limited to cruise ceiling. Therefore, fuel used to climb to (cruise ceiling) 19,000 ft must be read using the same method as shown in Example I. Also, distance covered and time elapsed in climbing to level-off altitude (19,000 ft) are determined from chart on page B3-3 using the same method as described in Example I.

EXAMPLE III.

Conditions: Configuration: Clean + (2) 450 gal tanks

Initial Gross Weight: 40,000 lb

Initial Altitude: 15,000 ft

Final Altitude: 25,000 ft

Climb Thrust Setting: Maximum

Climb Speed Schedule: Constant Recommended Mach Number

Ambient Temperature: Standard Day

Find: Fuel used to climb

Solution:

1. Determine the configuration drag index from the table on figure B1-5 by adding the various store drag numbers.

	Store	Location	Store Drag NO.
(1)	450 gal tank	Right Inb'd	14
(1)	450 gal tank	Left Inb'd	14
Configuration Drag Index =			28

2. Enter Sample Chart page B3-5 at a gross weight of 40,000 lb, (A).
3. Move horizontally to an altitude of 15,000 ft, (B).
4. Drop down to the configuration drag index of 28, (C).
5. Read a fuel used of 700 lb, (D) from the fuel scale on the left as the fuel used in climb from S.L. to 15,000 ft.
6. Again, enter Sample Chart page B3-5 at a gross weight of 40,000 lb, (A) and move horizontally to an altitude of 25,000 ft, (E).
7. Drop down to the configuration drag index of 28, (F).
8. Read a fuel used of 1100 lb, (G) from the fuel scale on the left as the fuel used in climb from S.L. to 25,000 ft.
9. Subtract the fuel used in climb to 15,000 ft (700 lb) from the fuel used to climb to 25,000 ft (1100 lb). The difference is the fuel used to climb from 15,000 ft to 25,000 ft (1100 lb - 700 lb = 400 lb).
10. The time and distance to climb from 15,000 ft to 25,000 ft may be obtained by the same method from figure B3-2.

model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST

F

FUEL USED, DISTANCE COVERED AND TIME ELAPSED FROM BRAKE RELEASE TO CLIMB SPEED (400 KCAS)

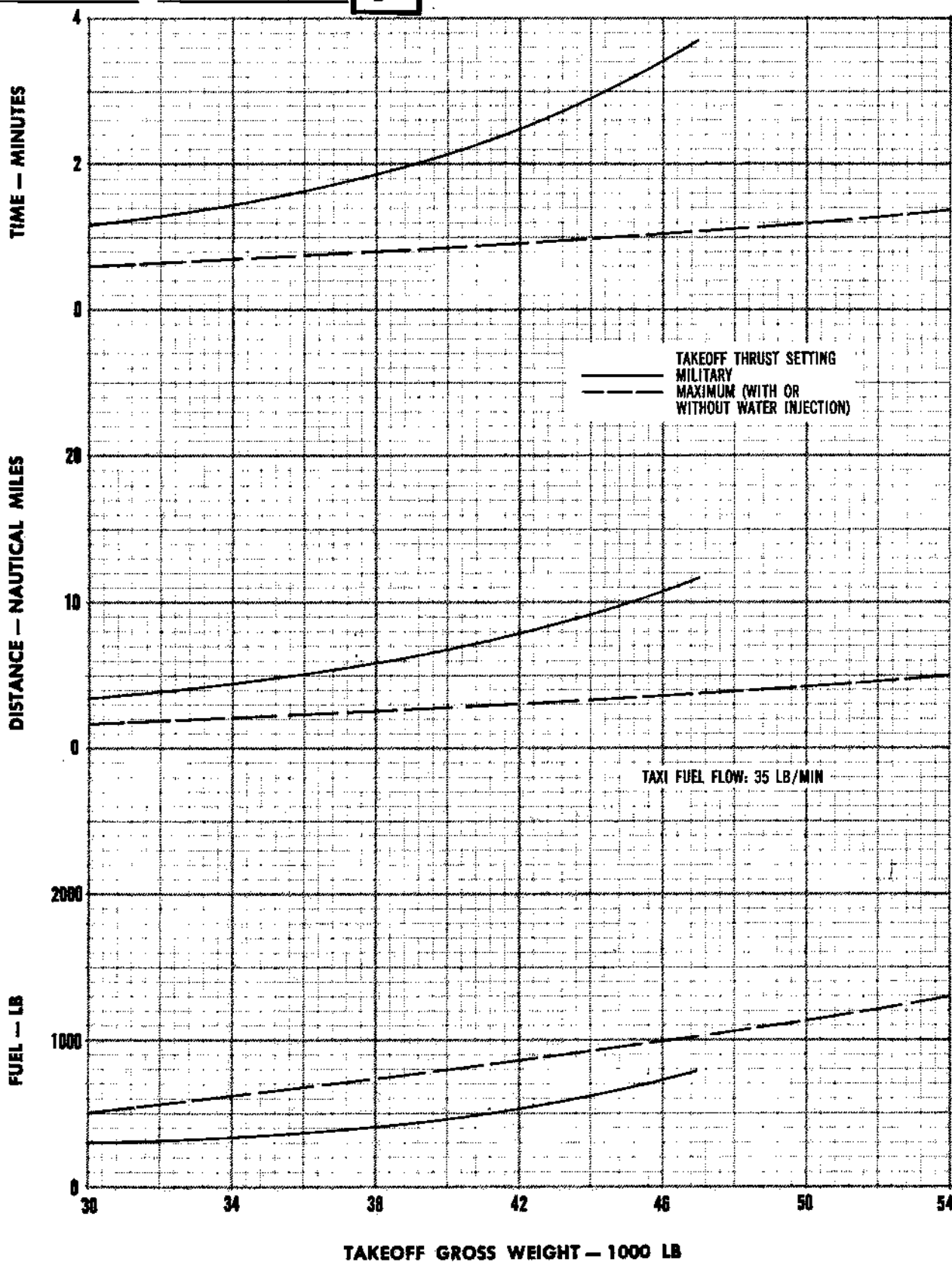


Figure B3-1

**MAXIMUM THRUST CLIMB
CONSTANT MACH NUMBER**
F

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

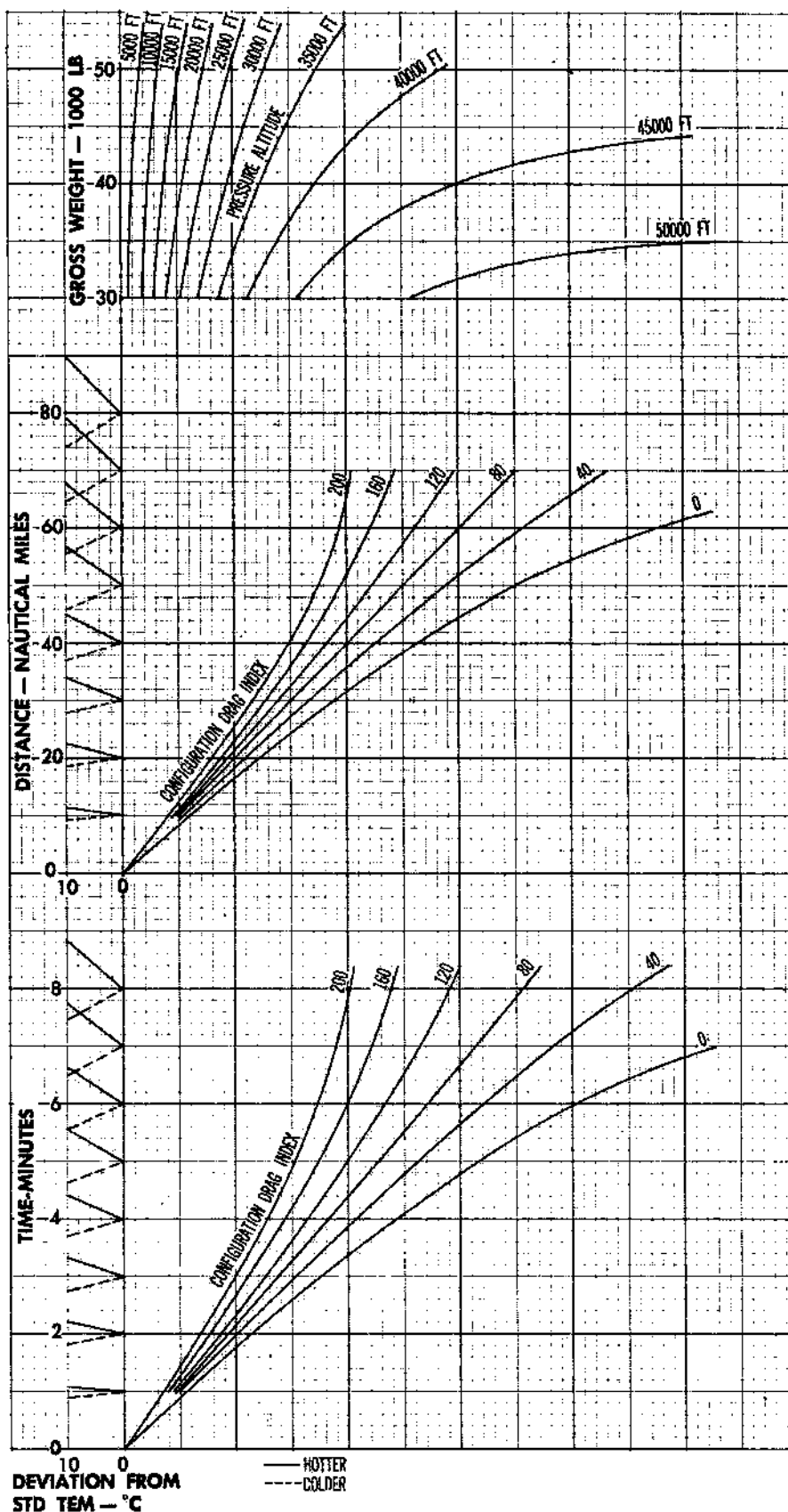
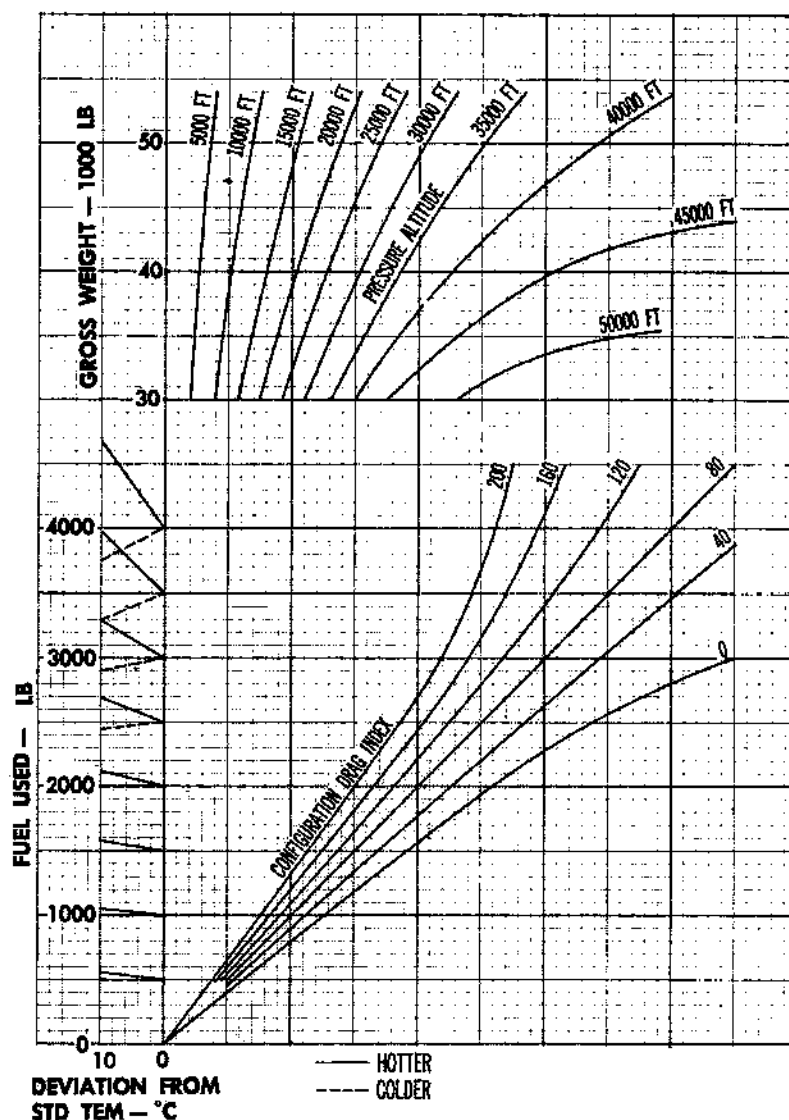


Figure B3-2 (Sheet 1 of 2)

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST



MAXIMUM THRUST CLIMB CONSTANT MACH NUMBER



NOTE:

1. Fuel allowance for engine start, taxi, takeoff and acceleration to climb speed is approximately 1500 LB.

CLIMB SCHEDULE

ALTITUDE (FEET)	DRAG INDEX 0-40	DRAG INDEX 40-80	DRAG INDEX 80-100	DRAG INDEX 100-120	DRAG INDEX 120-140	DRAG INDEX 140-160	DRAG INDEX 160-180	DRAG INDEX 180-200
	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH
S.L.	615 0.93	610 0.92	600 0.91	595 0.90	590 0.89	580 0.88	570 0.86	555 0.84
5000	570 0.93	560 0.92	555 0.91	550 0.90	545 0.89	540 0.88	525 0.86	515 0.84
10000	525 0.93	520 0.92	515 0.91	510 0.90	505 0.89	500 0.88	485 0.86	475 0.84
15000	480 0.93	475 0.92	470 0.91	465 0.90	460 0.89	455 0.88	440 0.86	430 0.84
20000	440 0.93	435 0.92	430 0.91	425 0.90	420 0.89	415 0.88	405 0.86	395 0.84
25000	400 0.93	395 0.92	390 0.91	385 0.90	380 0.89	375 0.88	365 0.86	355 0.84
30000	360 0.93	355 0.92	350 0.91	345 0.90	340 0.89	340 0.88	330 0.86	320 0.84
35000	320 0.93	320 0.92	315 0.91	310 0.90	305 0.89	300 0.88	295 0.86	285 0.84
40000	290 0.93	285 0.92	280 0.91	275 0.90	275 0.89	270 0.88	265 0.86	255 0.84
45000	255 0.93	250 0.92	250 0.91	245 0.90	245 0.89	240 0.88	235 0.86	225 0.84

Figure B3-2 (Sheet 2 of 2)

**MAXIMUM THRUST CLIMB
400 KCAS TO REC MACH NO.**
F

model:	F-105F
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 JULY 1964
data basis:	FLIGHT TEST

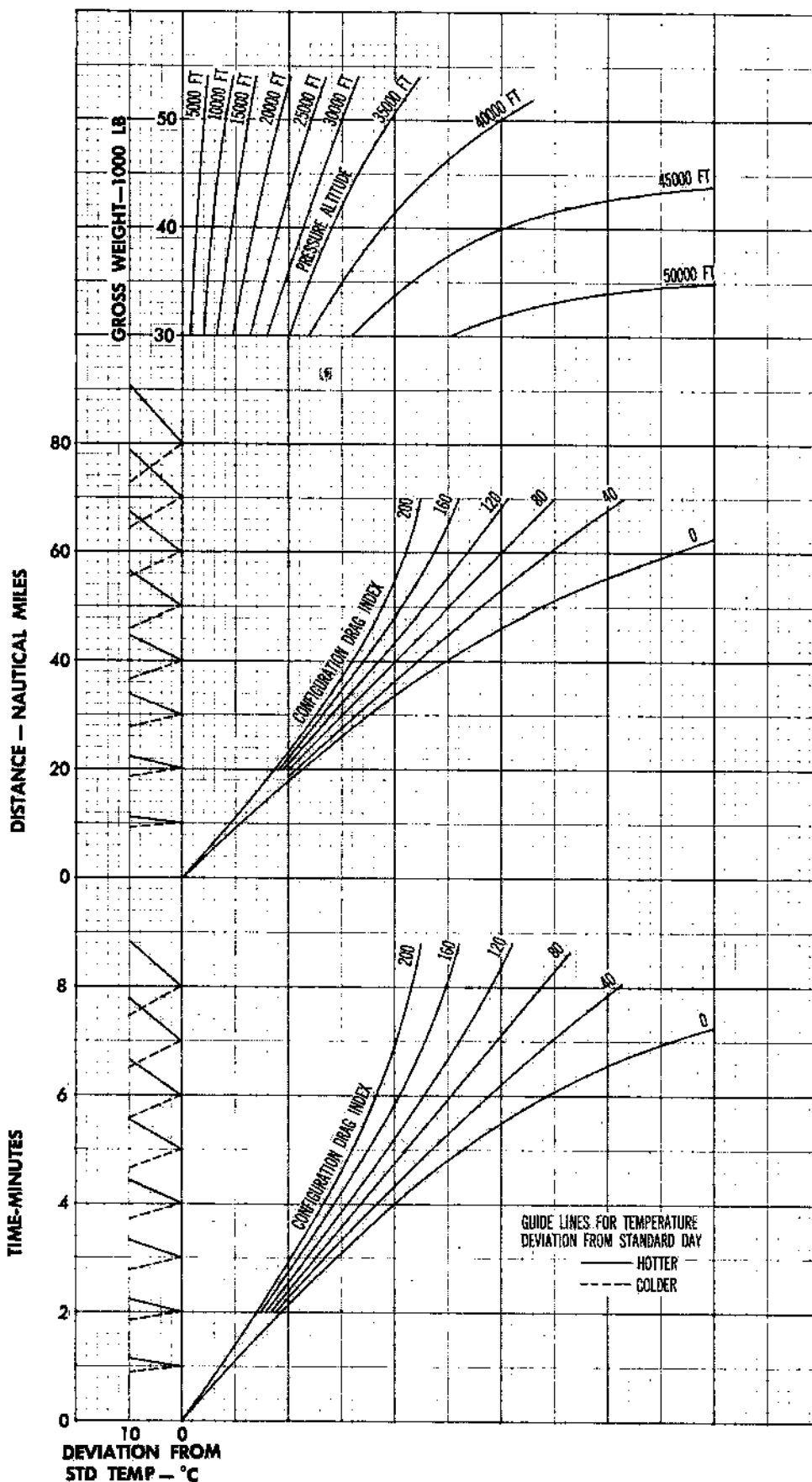
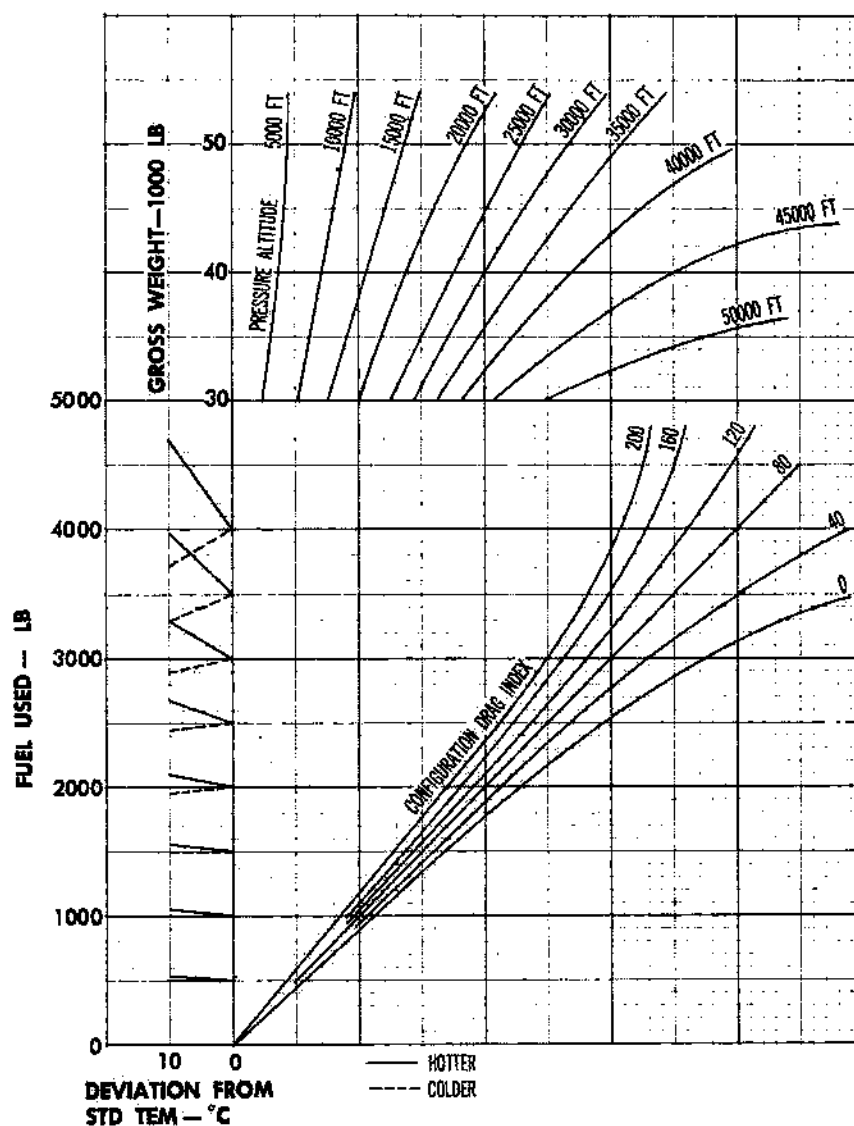


Figure B3-3 (Sheet 1 of 2)

model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST



**MAXIMUM THRUST CLIMB
400 KCAS TO REC MACH NO.**



NOTE:

1. Fuel allowance for engine start, taxi, takeoff and acceleration to climb speed is approximately 1500 LB.

CLIMB SCHEDULE

ALTITUDE (FEET)	DRAG INDEX 0-40	DRAG INDEX 40-80	DRAG INDEX 80-100	DRAG INDEX 100-120	DRAG INDEX 120-140	DRAG INDEX 140-160	DRAG INDEX 160-180	DRAG INDEX 180-200
	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH
S.L.	400 0.61	400 0.61	400 0.61	400 0.61	400 0.61	400 0.61	400 0.61	400 0.61
5000	400 0.66	400 0.66	400 0.66	400 0.66	400 0.66	400 0.66	400 0.66	400 0.66
10000	400 0.71	400 0.71	400 0.71	400 0.71	400 0.71	400 0.71	400 0.71	400 0.71
15000	400 0.78	400 0.78	400 0.78	400 0.78	400 0.78	400 0.78	400 0.78	400 0.78
20000	400 0.85	400 0.85	400 0.85	400 0.85	400 0.85	400 0.85	400 0.85	395 0.84
25000	400 0.93	395 0.92	390 0.91	385 0.90	380 0.89	375 0.88	365 0.86	355 0.84
30000	360 0.93	355 0.92	350 0.91	345 0.90	340 0.89	340 0.88	330 0.86	320 0.84
35000	320 0.93	320 0.92	315 0.91	310 0.90	305 0.89	300 0.88	295 0.86	285 0.84
40000	290 0.93	285 0.92	280 0.91	275 0.90	275 0.89	270 0.88	265 0.86	255 0.84
45000	255 0.93	250 0.92	250 0.91	245 0.90	245 0.89	240 0.88	235 0.86	225 0.84

Figure B3-3 (Sheet 2 of 2)

MILITARY THRUST CLIMB **400 KCAS TO RECOMMENDED** **MACH NO.**

F

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

GUIDE LINES FOR TEMPERATURE
 DEVIATION FROM STANDARD DAY
 — HOTTER
 - - - COLDER

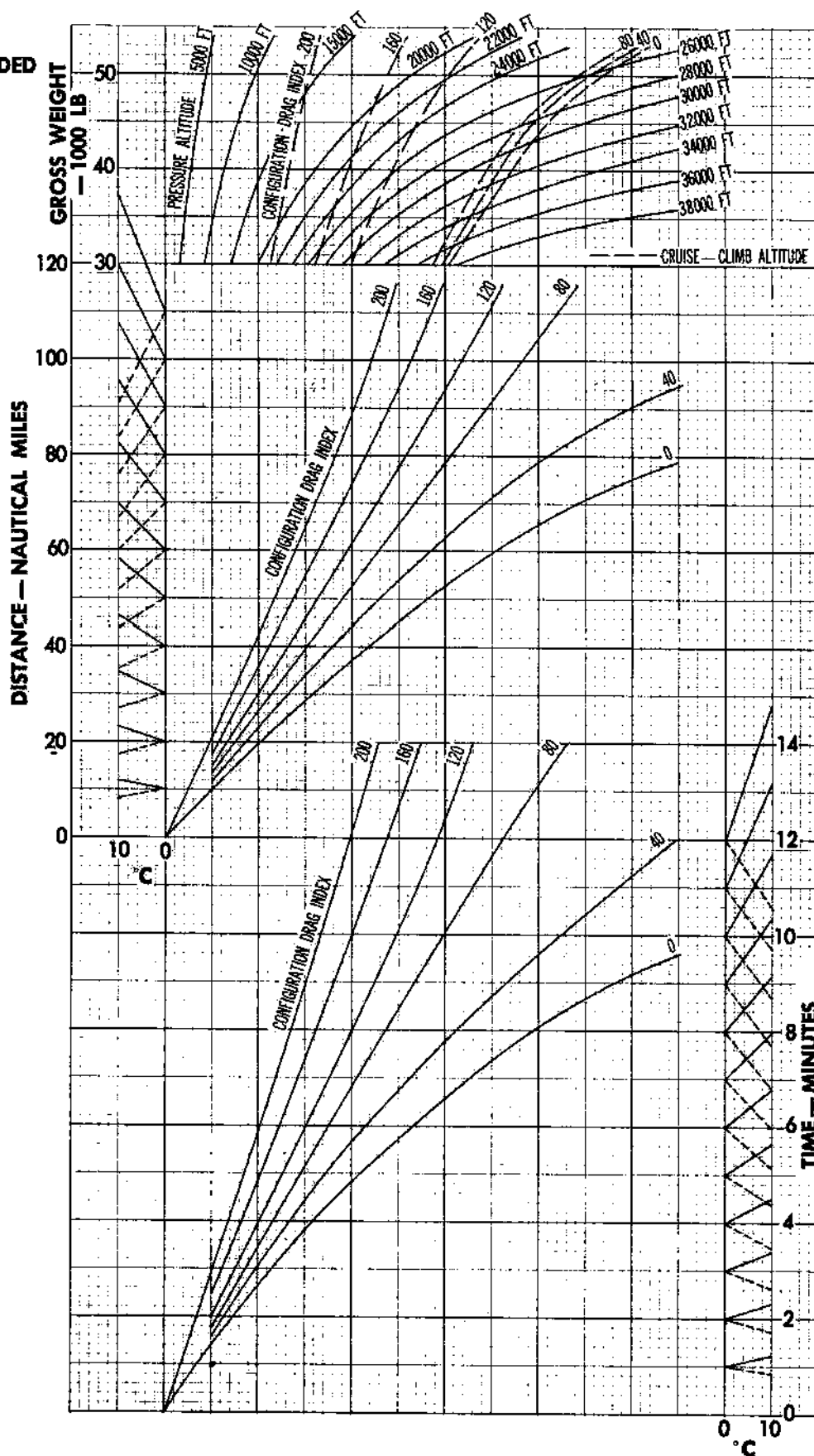
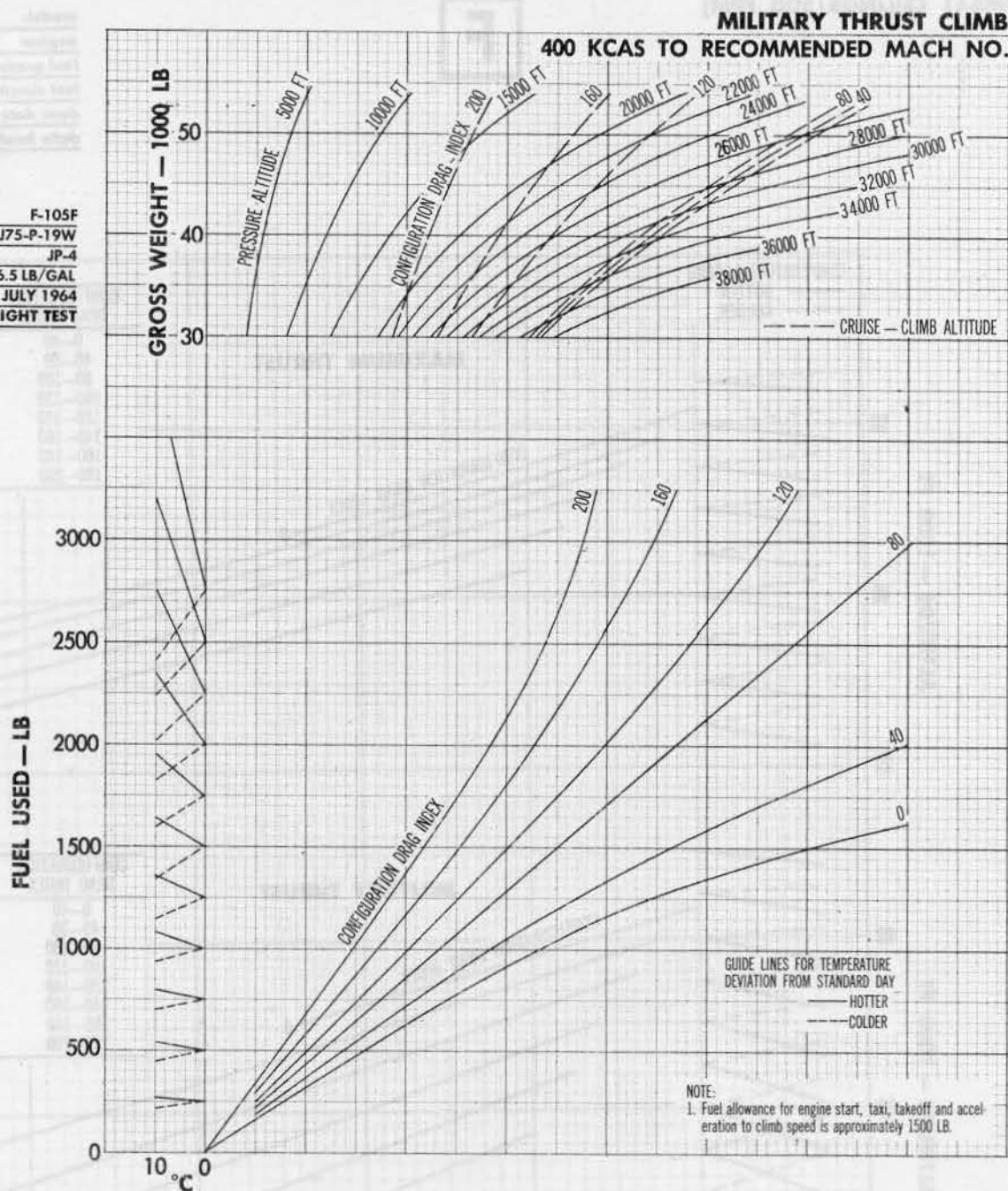


Figure B3-4 (Sheet 1 of 2)

F

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST



CLIMB SCHEDULE

ALTITUDE (FEET)	DRAG INDEX 0-40	DRAG INDEX 40-80	DRAG INDEX 80-100	DRAG INDEX 100-120	DRAG INDEX 120-140	DRAG INDEX 140-160	DRAG INDEX 160-180	DRAG INDEX 180-200
	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH	KCAS-MACH
S.L.	400 0.61	400 0.61	400 0.61	400 0.61	400 0.61	400 0.61	400 0.61	400 0.61
5000	400 0.66	400 0.66	400 0.66	400 0.66	400 0.66	400 0.66	400 0.66	400 0.66
10000	400 0.71	400 0.71	400 0.71	400 0.71	400 0.71	400 0.71	400 0.71	400 0.71
15000	400 0.78	400 0.78	400 0.78	400 0.78	400 0.78	390 0.76	370 0.73	360 0.71
20000	400 0.85	400 0.85	400 0.85	385 0.82	370 0.79	355 0.76	340 0.73	330 0.71
25000	375 0.88	370 0.87	360 0.85	345 0.82	335 0.79	320 0.76	305 0.73	295 0.71
30000	340 0.88	335 0.87	325 0.85	315 0.82	300 0.79	285 0.76	275 0.73	265 0.71
35000	300 0.88	295 0.87	290 0.85	280 0.82	265 0.79	255 0.76	245 0.73	240 0.71
40000	270 0.88	265 0.87	260 0.85	250 0.82	240 0.79	230 0.76	220 0.73	215 0.71

Figure B3-4 (Sheet 2 of 2)

COMBAT CEILINGS (500 FPM)

F

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

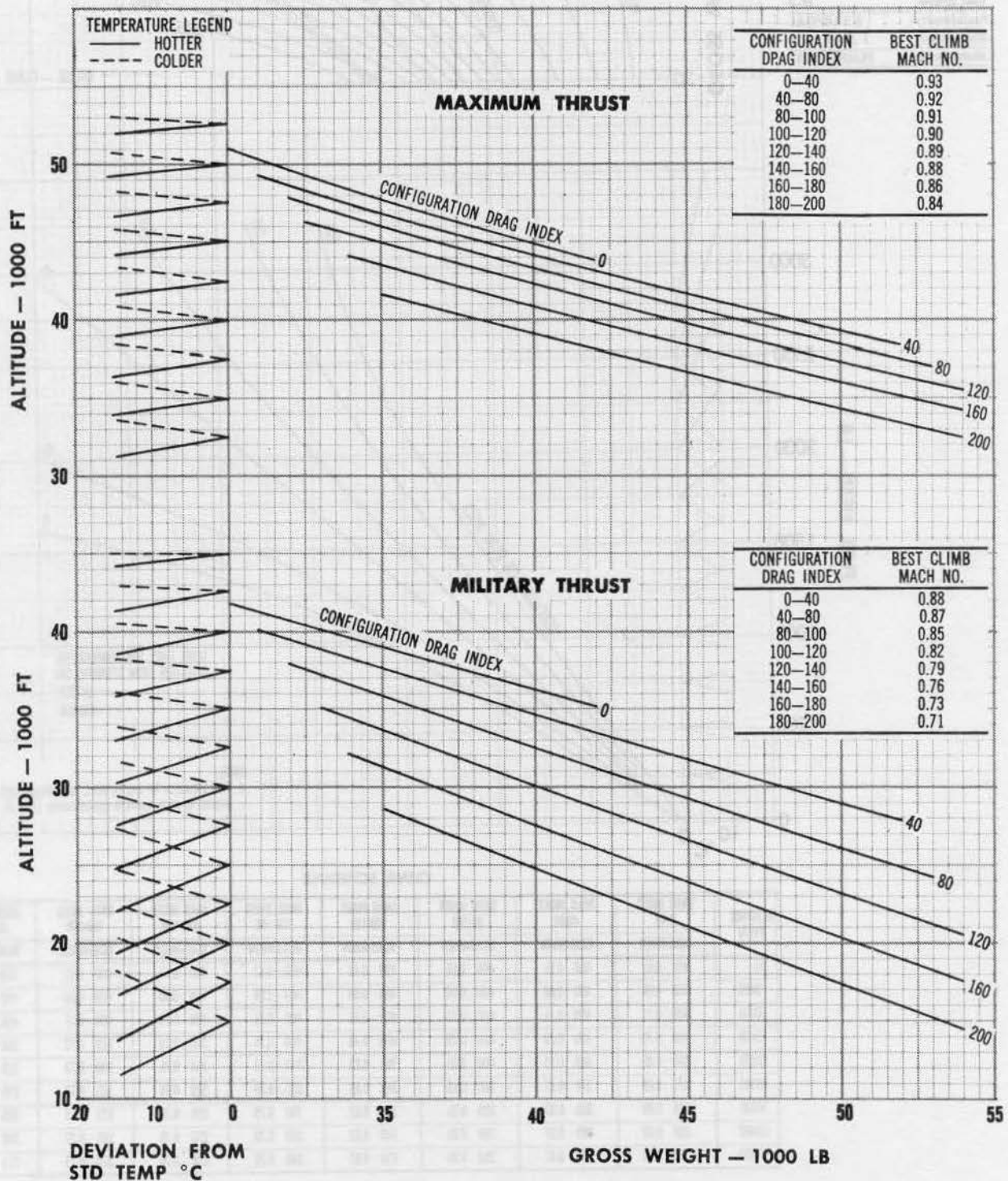


Figure B3-5 (Sheet 1 of 2)

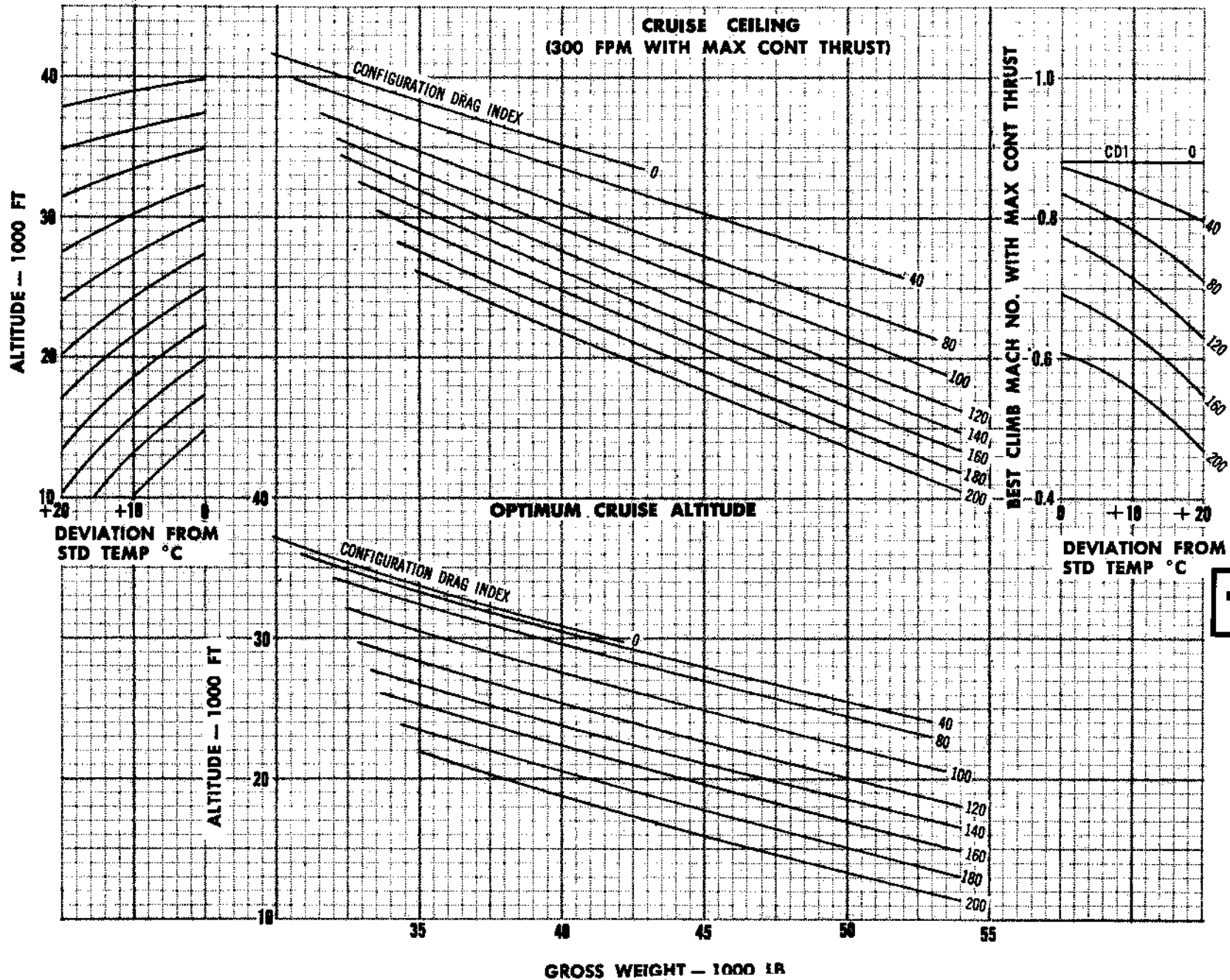


Figure B3-5 (Sheet 2 of 2)

MILITARY THRUST CLIMB **KC-135/F-105F** **BUDDY CLIMB** **SPEED SCHEDULE**

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

INITIAL GROSS WEIGHT — 1000 LB

F

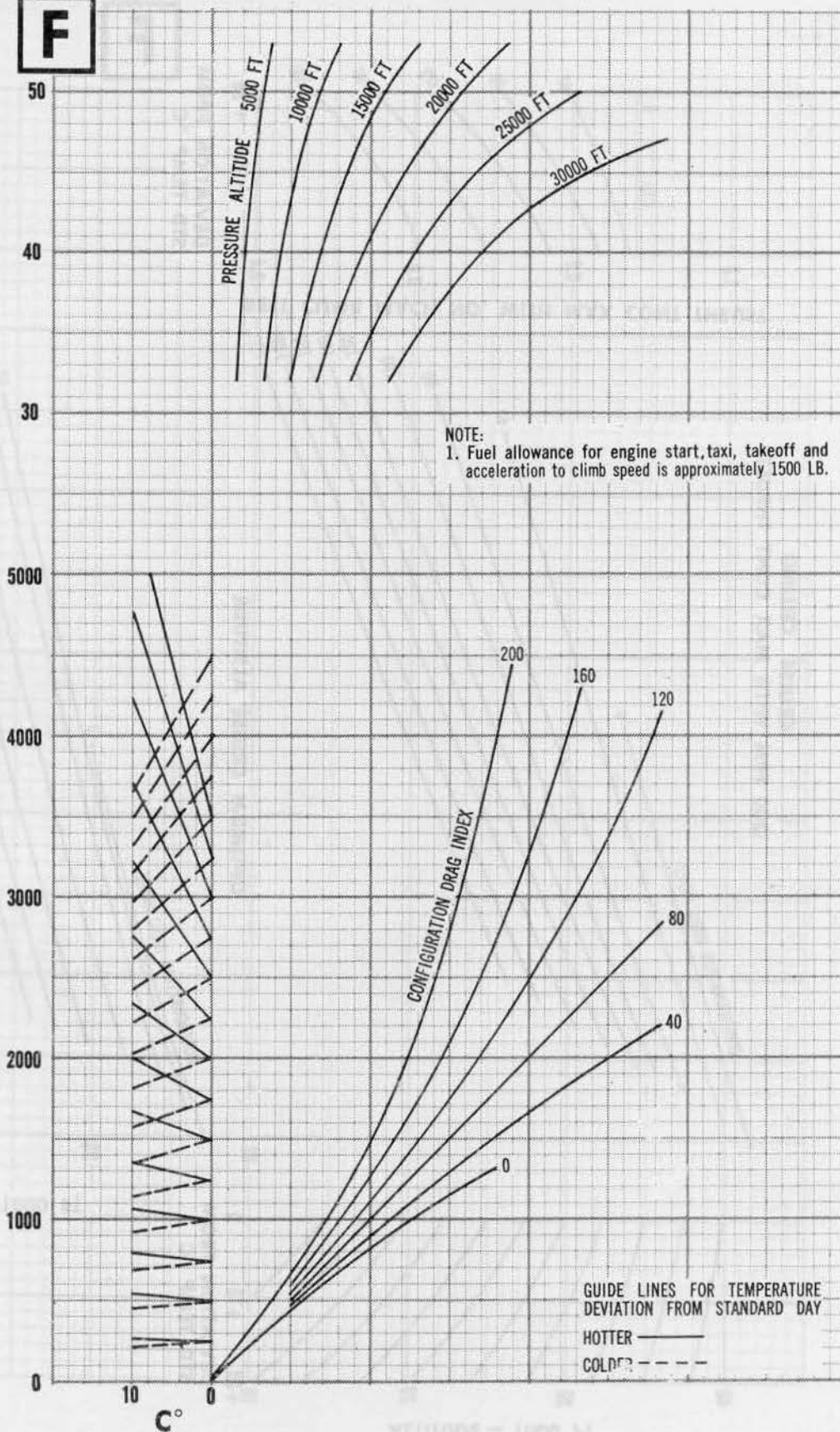


Figure B3-6 (Sheet 1 of 2)

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST



MILITARY THRUST CLIMB
KC135/F-105F BUDDY
CLIMB SPEED SCHEDULE

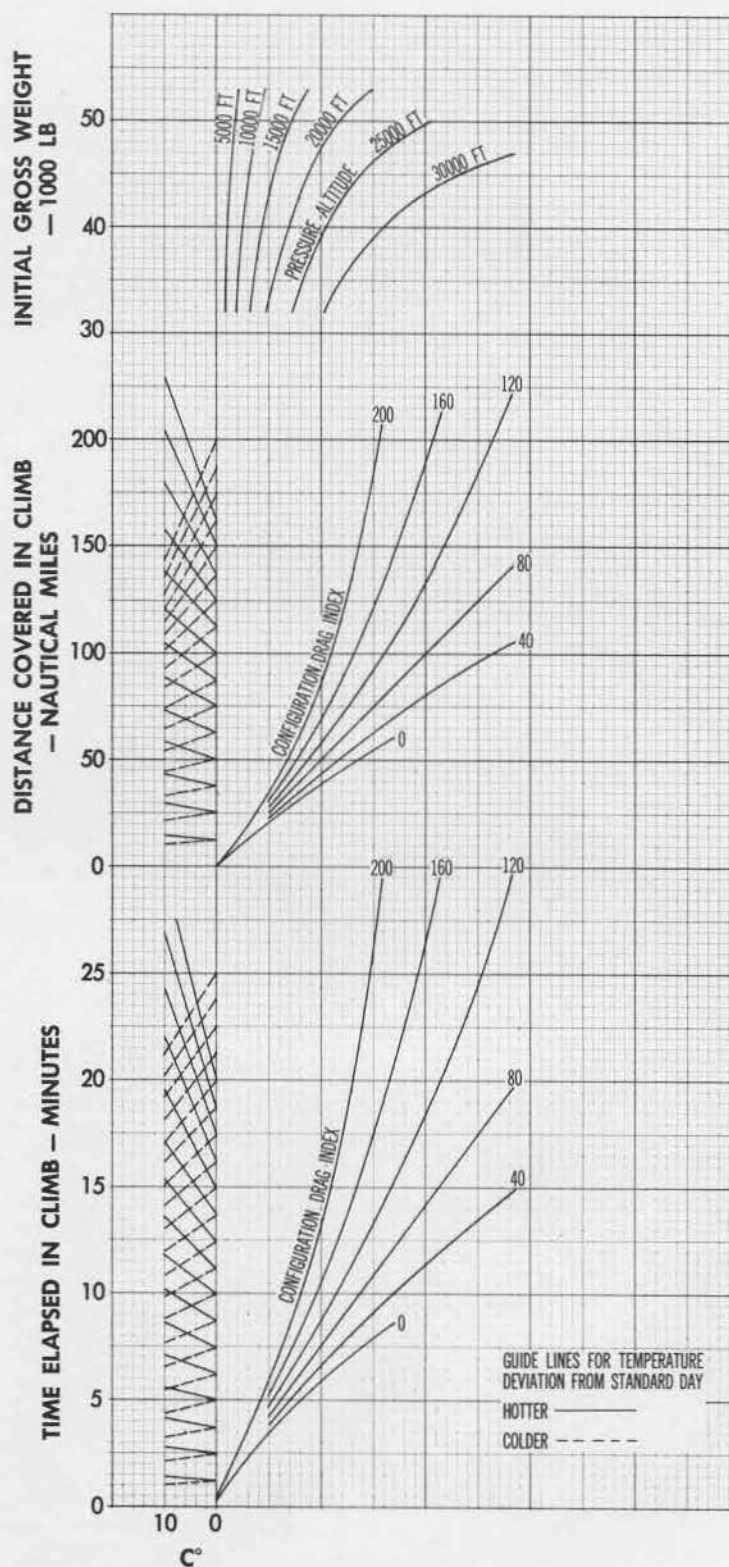


Figure B3-6 (Sheet 2 of 2)

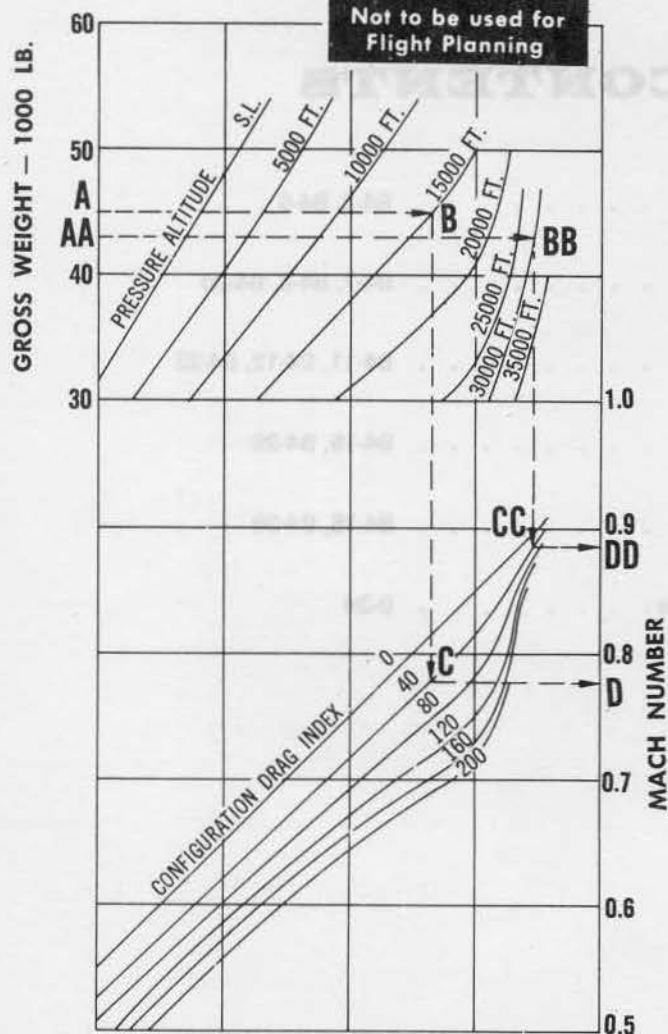
PART 4 RANGE**TABLE OF CONTENTS**

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**CONSTANT ALTITUDE
LONG RANGE CRUISE
MACH NO. AND TIME**



SAMPLE CHART
Not to be used for
Flight Planning



**CONSTANT ALTITUDE LONG RANGE CRUISE
INFORMATION**

From the constant altitude cruise curves the pilot can determine: 1) Speed for long range cruise, 2) Distance available for a given fuel quantity or fuel required to fly a given distance, and 3) Time elapsed during the cruise segment of (2) above, with wind and temperature conditions included.

EXAMPLE I

Conditions: Configuration: Clean + 650 gal tank (centerline) + (2) 450 gal tanks (inboard)

Initial Gross Weight: 47,000 lb

Cruise Pressure Altitude: 15,000 ft

Winds: Average 50 knot headwind

Ambient Temperature: 20°C warmer than standard

Find: Cruise Mach number, fuel required and time elapsed to fly 350 NMi Ground Distance.

Solution:

1. Determine the configuration drag index from figure B1-5 by adding the various store drag numbers.

Store	Location	Store Drag NO.
(1) 650 gal tank	Centerline	14
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb'd	<u>14</u>
Configuration Drag Index = 42		

2. Read Standard Day temperature at 15,000 ft pressure altitude from Standard Atmosphere Table (figure B1-10) = -14.718°C.
Ambient temperature =
-14.718° + 20° = +5.282°C.

3. Estimate Average Gross Weight
Initial Gross Weight = 47,000 lb
Estimated Fuel Used = 4000 lb
Estimated Final Gross Weight = 43,000 lb
Estimated Average
Gross Weight = $\frac{47,000 + 43,000}{2} = 45,000$ lb

4. Enter sample chart page B4-2 at estimated average gross weight = 45,000 lb (A). Move to the right and intercept pressure altitude = 15,000 ft at (B), and project down to the configuration drag index number = 42° (C). Move to

the right and read estimated constant altitude cruise Mach number = 0.777 (D).

5. Enter sample chart page B4-4 estimated cruise Mach number = 0.777 (E). Parallel the guide lines from (E) until the ambient temperature (+5.3°C) is intercepted at (F). From (F) move to the right and intercept the 50 knot headwind line at (G). Continue from (G) to the zero wind - true airspeed reflector line (H). Drop down to the velocity scale and read TAS = 505 knots, (J). From (G) extend a vertical line upward to the required range line = 350 NMi, (K). From (K) move to the left and read estimated elapsed time = 46 minutes, (L).
6. Enter sample chart page B4-5 at estimated average gross weight = 45,000 lb, (M). Move horizontally to cruise altitude = 15,000 ft, (N). Drop vertically to configuration drag index number = 52, (P). Move horizontally to true airspeed = 505 knots, (Q), move up and intercept estimated elapsed time = 46 minutes, (R). Move to the left and read fuel used = 5550 lb, (S).

7. Revised Estimated Average Gross Weight

Initial Gross Weight = 47,000 lb

Fuel Used Reading = 5550 lb

Final Gross Weight = 41,450 lb

Average Gross

$$\text{Weight} = \frac{47,000 + 41,450}{2} = 44,225 \text{ lb}$$

8. Reworking steps 4, 5, and 6 with revised average gross weight = 44,475 lb, the respective readings are:

Mach Number	0.77
True Airspeed	500 knots
Elapsed Time	46.5 minutes
Fuel Used	5405 lb

Calibrated airspeed can be read from figure B4-1 at 0.77 Mach number and 15,000 ft as 395 KCAS.

EXAMPLE II

Conditions: Configuration: Clean + (2) 450 gal tanks (inboard) + (2) AGM-12B (outboard)

Initial Gross Weight: 44,000 lb

Cruise Altitude: 30,000 ft

Wind: Average 50 knot tailwind

Ambient Temperature: 10°C colder than standard

Find: Cruise Mach number, ground distance available and time elapsed in cruising with 2000 lb of fuel.

Solution:

1. Determine the configuration drag index from figure B1-5 by adding the various store drag numbers.

Store	Location	Store Drag NO.
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb.d	14
(1) AGM-12B	Left outb'd (in the presence of inb'd fuel tank)	13
(1) AGM-12B	Right outb'd (in the presence of inb'd fuel tank)	13
Configuration Drag Index =		54

2. From figure B1-10 read standard day temperature at 30,000 ft pressure altitude = -44.436°C. Ambient temperature = -44.436 - 10 = -54.436°C.
3. Determine Average Gross Weight
Initial Gross Weight = 44,000 lb
Fuel Used in Cruise = 2000 lb
Final Gross Weight = 42,000 lb
Average Gross
$$\text{Weight} = \frac{44,000 + 42,000}{2} = 43,000 \text{ lb}$$
4. Enter sample chart page B4-2 at average gross weight = 43,000 lb, (AA), move to the right to cruise altitude = 30,000 ft, (BB), drop vertically to configuration drag index = 54 (CC), move to the right and read cruise Mach number = 0.883, (DD).
5. Enter sample chart page B4-4 at cruise Mach number = 0.883, (EE). Parallel the guide lines from (EE) until the ambient temperature (-54°C) is intercepted at (FF). From (FF) move to the right and intercept the zero wind;

true airspeed reflector line at (GG). Drop down to the velocity scale and read true airspeed = 511 knots. (HH). Continue from (GG) horizontally to the 50 knot tail wind line, (JJ). From (JJ) project a vertical line into the time — ground distance plot.

6. Enter sample chart page B4-5 at average gross weight = 43,000 lb, (KK). Move horizontally to cruise altitude = 30,000 ft,

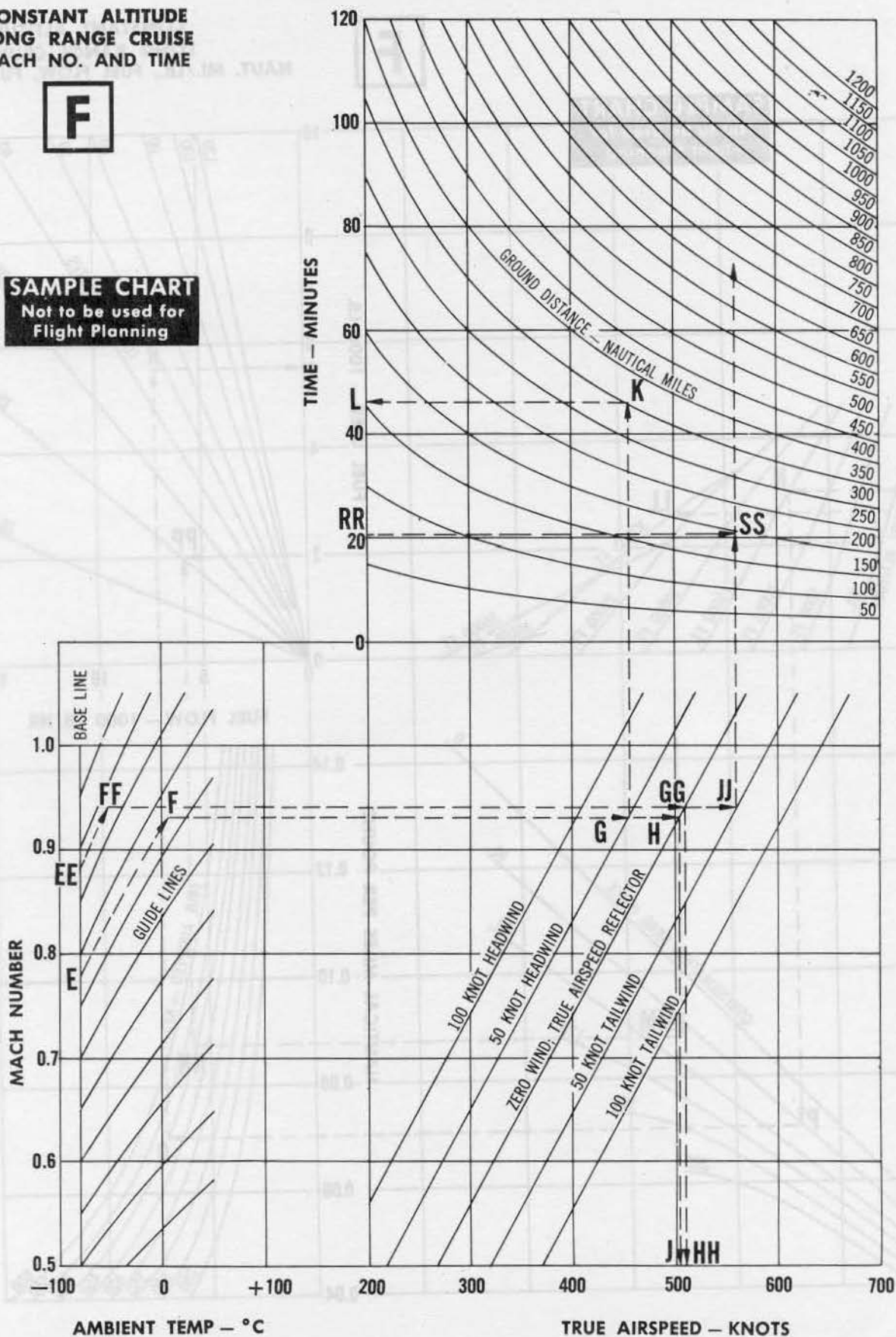
(LL). Drop down to configuration Drag Index number = 54 (MM). From (MM) move horizontally across to true airspeed = 511 knots. (NN). Move up to fuel used = 2000 lb and read time elapsed = 20.5 minutes at (PP).

7. Re-enter sample chart page B4-4 at elapsed time = 20.5 minutes (RR). Move to the right and intercept line from (JJ) and read ground distance = 190 NMi, (SS).

CONSTANT ALTITUDE
LONG RANGE CRUISE
MACH NO. AND TIME

F

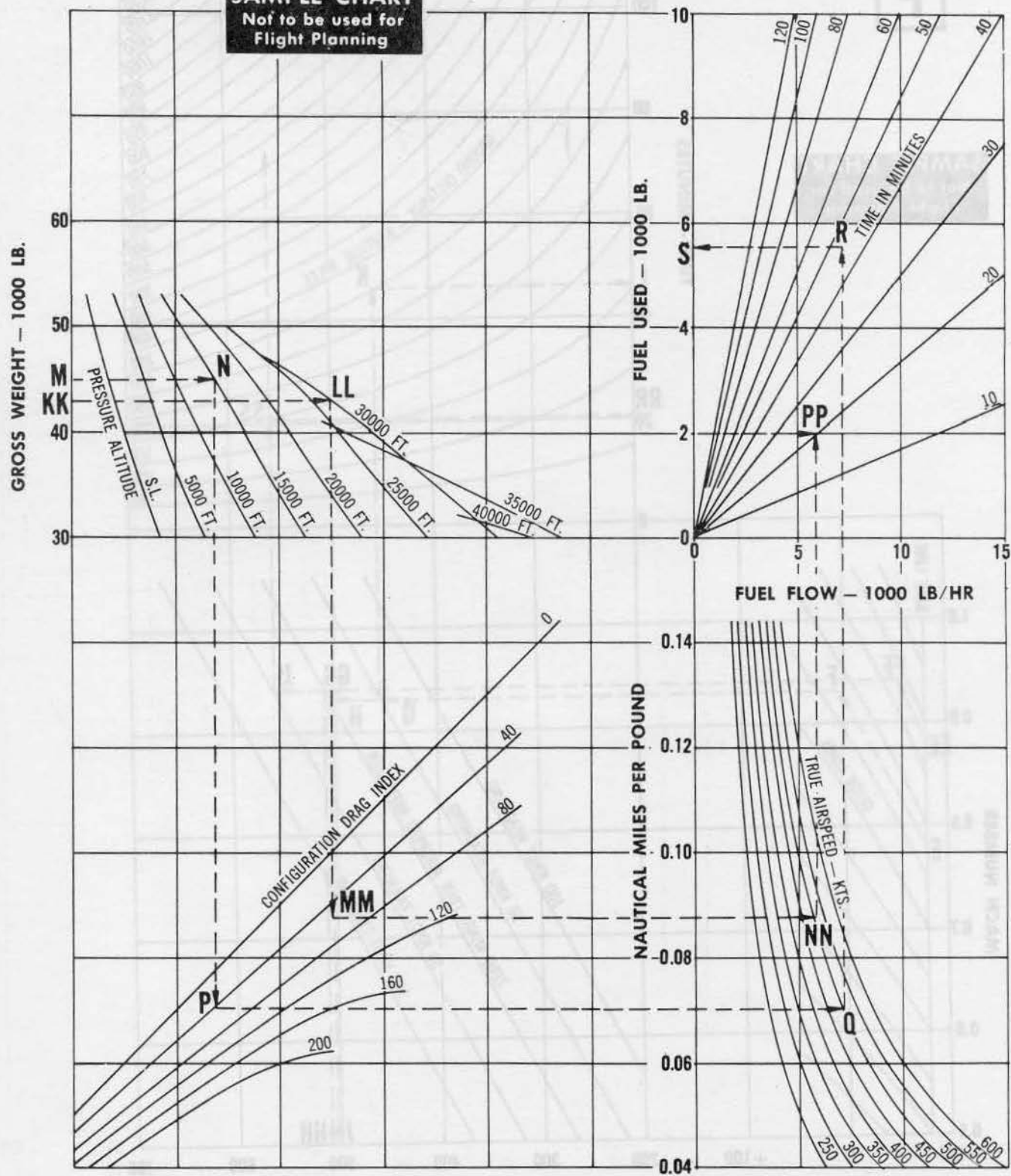
SAMPLE CHART
Not to be used for
Flight Planning



F

**CONSTANT ALTITUDE
LONG RANGE CRUISE**
NAUT. MI./LB., FUEL FLOW, FUEL

SAMPLE CHART
Not to be used for
Flight Planning

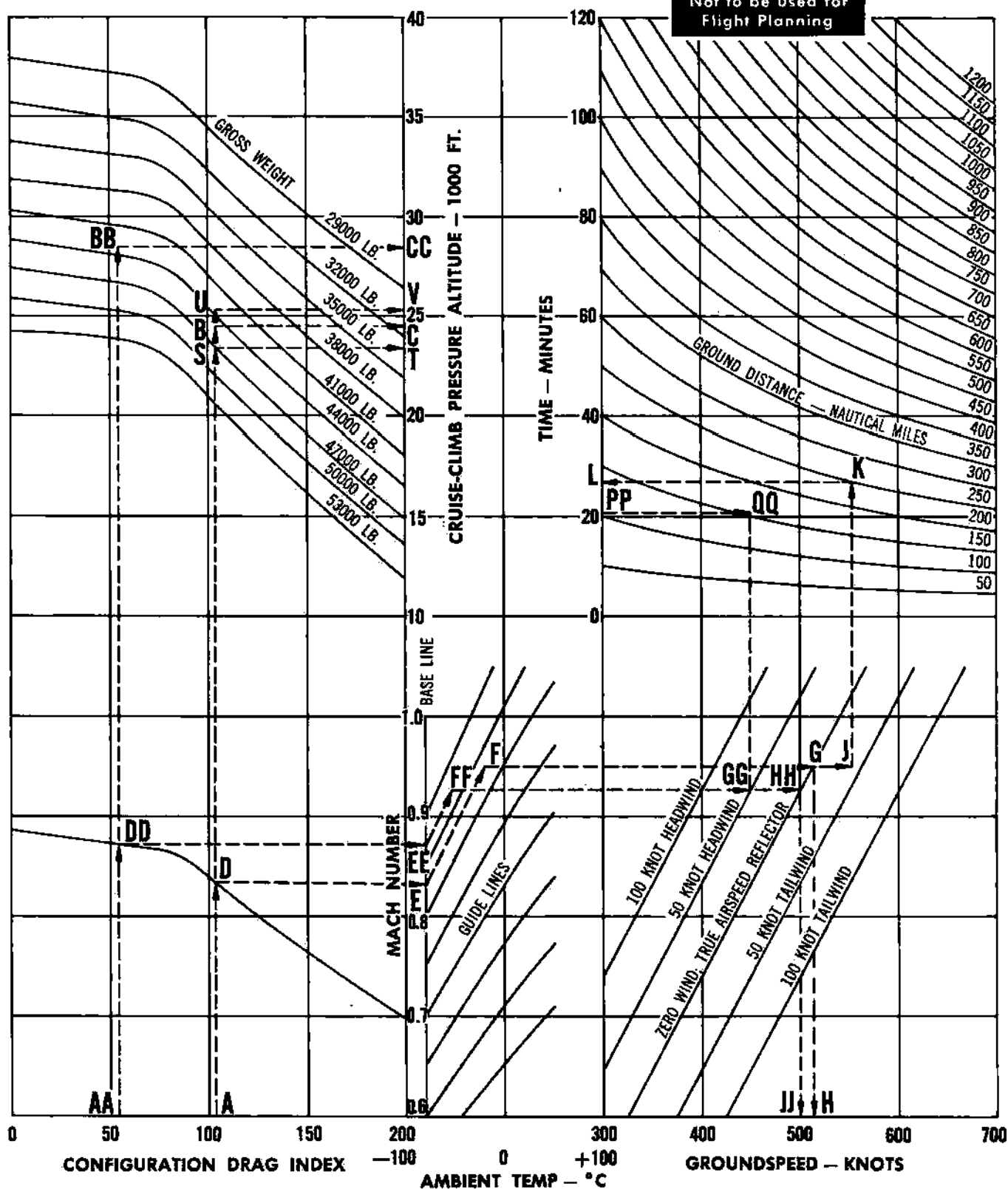


CRUISE CLIMB PERFORMANCE
CRUISE ALTITUDE, MACH NUMBER AND TIME

F

SAMPLE CHART

Not to be used for
Flight Planning



CRUISE CLIMB INFORMATION

From the cruise-climb curves the pilot can determine:

- 1) Mach number for long range cruise, 2) Altitudes for long range cruise, 3) Fuel required to fly a given distance, or distance covered for a given fuel quantity, 4) Time elapsed during cruise segment of (3) above, with wind and temperature corrections as applicable.

EXAMPLE I

Conditions: Configuration: Clean + (6) 750 lb bombs (centerline) + (2) 450 gal tanks (inboard)

Initial Gross Weight: 47,000 lb

Winds: Average 40 knot tailwind

Ambient Temperature: 15°C warmer than standard

Find: 1) Cruise Mach number and altitudes for long range cruise

2) Fuel required and time elapsed to fly 250 NMi.

Solution:

1. Determine configuration drag index from figure B1-5 by adding the various store drag numbers

Store	Location	Store Drag NO.
(6) 750 lb bombs	Centerline	75
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb'd	14
Configuration Drag Index = 103		

2. Estimate Average Gross Weight

Initial Gross Weight = 47,000 lb

Estimated Fuel Used = 4000 lb

Estimated Final Gross Weight = 43,000 lb

Estimated Average

Gross Weight = $\frac{47,000 + 43,000}{2} = 45,000$ lb

3. Enter sample chart page B4-6 at configuration drag index = 103 (A), move up to estimated average gross weight (45,000 lb) (B), move to the right and read estimated average cruise pressure altitude = 24,500 ft, (C).

4. Enter ICAO density altitude chart, figure B1-9, with estimated cruise pressure altitude = 24,500 ft and read standard day temperature (-34°C). Ambient temperature = $(-34 + 15) = -19^\circ\text{C}$.

5. Re-enter sample chart page B4-6 at configuration drag index = 103 (A), move up to line (D), move across to the Mach number scale and read cruise Mach number = 0.833 (E). Parallel the guide lines from (E), until the ambient temperature (-19°C) is intercepted at (F). From (F), move to the right and intercept the zero wind-true airspeed reflector line, (G). Drop down to the velocity scale and read TAS = 514 knots, (H). (Ground speed at zero wind.) From (G) continue across to a 40 knot tailwind at (J), and move up to the required range line = 250 NMi, (K). Move to the left and read elapsed time = 27 minutes, (L).

6. Enter sample chart page B4-8 at estimated gross weight = 45,000 lb, (M). Move up to configuration drag index = 103, (N). Move to the right and intercept true airspeed = 514 knots at (P) (see step 5). Move up to a time of 27 minutes, (Q) (see step 5), and move to the fuel used scale to read 3200 lb of fuel, (R).

7. Revise Estimated Average Gross Weight

Initial Gross Weight = 47,000 lb

Fuel Used Reading = 3200 lb

Final Gross Weight = 43,800 lb

Average Gross

Weight = $\frac{47,000 + 43,800}{2} = 45,400$ lb

8. Reworking steps 3, 4, 5 and 6 with revised average gross weight = 45,400 lb, the respective readings are:

Average Cruise-Climb Altitude = 24,300 ft

Temperature $(-33.5^\circ\text{C} + 15) = -18.5^\circ\text{C}$

True Airspeed = 514 knots

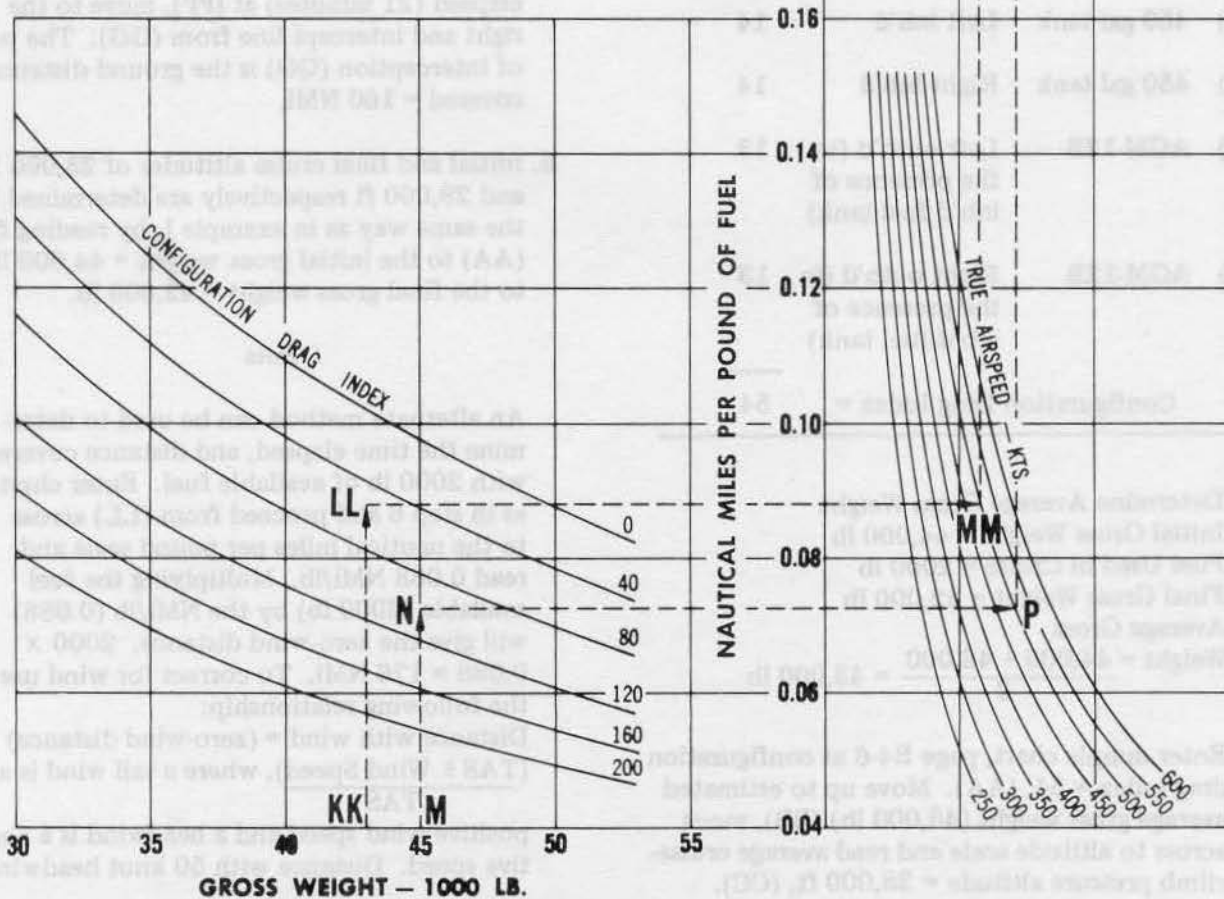
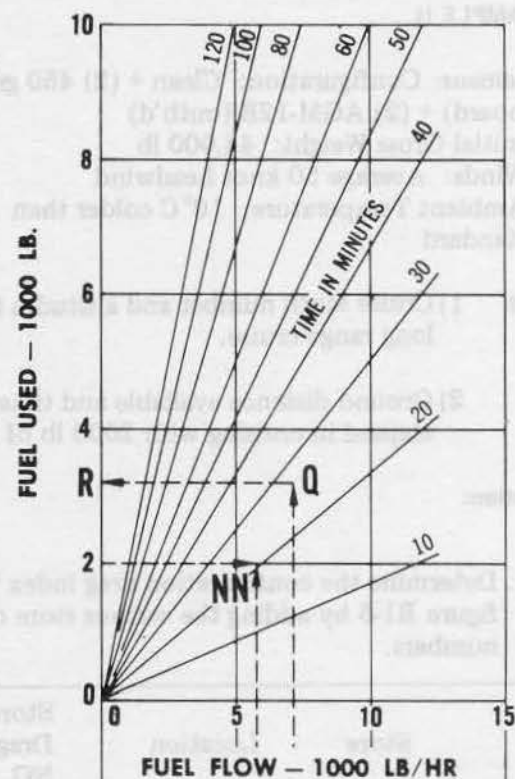
Time = 27 minutes

Fuel Used = 3210 lb

9. To find initial and final cruise-climb altitude enter sample chart page B4-6 at configuration drag index = 103, (A). Proceed to the initial gross weight = 47,000 lb, (S), move to the right and read initial cruise-climb pressure altitude, 23,400 ft, (T). Continue from (S) to final gross weight = 43,800 lb, (U). Move across and read final cruise pressure altitude, 25,250 ft, (V).

CRUISE CLIMB PERFORMANCE

NAUT. MI./LB., FUEL FLOW, FUEL

F

EXAMPLE II

Conditions: Configuration: Clean + (2) 450 gal tanks (inboard) + (2) AGM-12B (outb'd)

Initial Gross Weight: 44,000 lb

Winds: Average 50 knot headwind

Ambient Temperature: 10°C colder than standard

- Find:** 1) Cruise Mach number and altitudes for long range cruise.
- 2) Ground distance available and time elapsed in cruising with 2000 lb of fuel.

Solution:

1. Determine the configuration drag index from figure B1-5 by adding the various store drag numbers.

Store	Location	Store Drag NO.
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb'd	14
(1) AGM-12B	Left outb'd (in the presence of inb'd fuel tank)	13
(1) AGM-12B	Right outb'd (in the presence of inb'd fuel tank)	13
Configuration Drag Index =		54

2. Determine Average Gross Weight

Initial Gross Weight = 44,000 lb

Fuel Used in Cruise = 2000 lb

Final Gross Weight = 42,000 lb

Average Gross

Weight = $\frac{44,000 + 42,000}{2} = 43,000 \text{ lb}$

3. Enter sample chart, page B4-6 at configuration drag index = 54, (AA). Move up to estimated average gross weight (43,000 lb) (BB), move across to altitude scale and read average cruise-climb pressure altitude = 28,000 ft, (CC).

4. Enter ICAO density altitude chart, figure B1-9, at cruise-climb pressure altitude and read

standard day temperature = 43°C.

Ambient temperature = $-43^{\circ}\text{C} + -10^{\circ}\text{C} = 53^{\circ}\text{C}$.

5. Re-enter sample chart page B4-6 at configuration drag index = 54, (AA). Move up to line, (DD), move across to the Mach number scale and read cruise Mach number = 0.871, (EE). Continue from (EE), parallel to the guide lines until the ambient temperature (-53°C) is intercepted at (FF), move to the right until the 50 knot headwind is intercepted at (GG). Continue from (GG) to the zero wind-true airspeed reflector line (HH). Drop down to the velocity scale and read TAS = 500 knots, (JJ). From (GG) extend a line upward into the time-ground distance plot.
6. Enter sample chart page B4-8 at average gross weight = 43,000 lb, (KK), and move up to configuration drag index = 54, (LL). Move to the right to true airspeed -500 knots, (MM). From (MM) move up to fuel available = 2000 lb at (NN) and read time elapsed = 21 minutes.
7. Re-enter sample chart page B4-6 with time elapsed (21 minutes) at (PP), move to the right and intercept line from (GG). The point of interception (QQ) is the ground distance covered = 160 NMi.
8. Initial and final cruise altitudes of 28,000 ft and 29,000 ft respectively are determined in the same way as in example I, by reading from (AA) to the initial gross weight = 44,000 lb and to the final gross weight = 42,000 lb.

Note

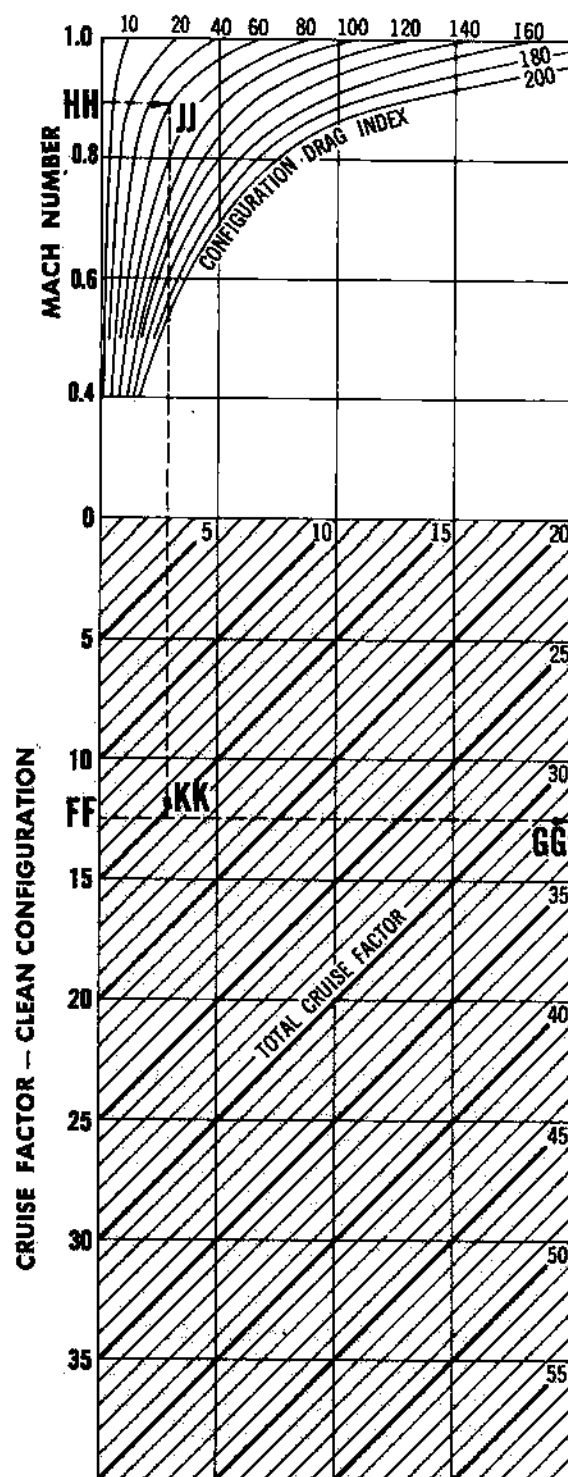
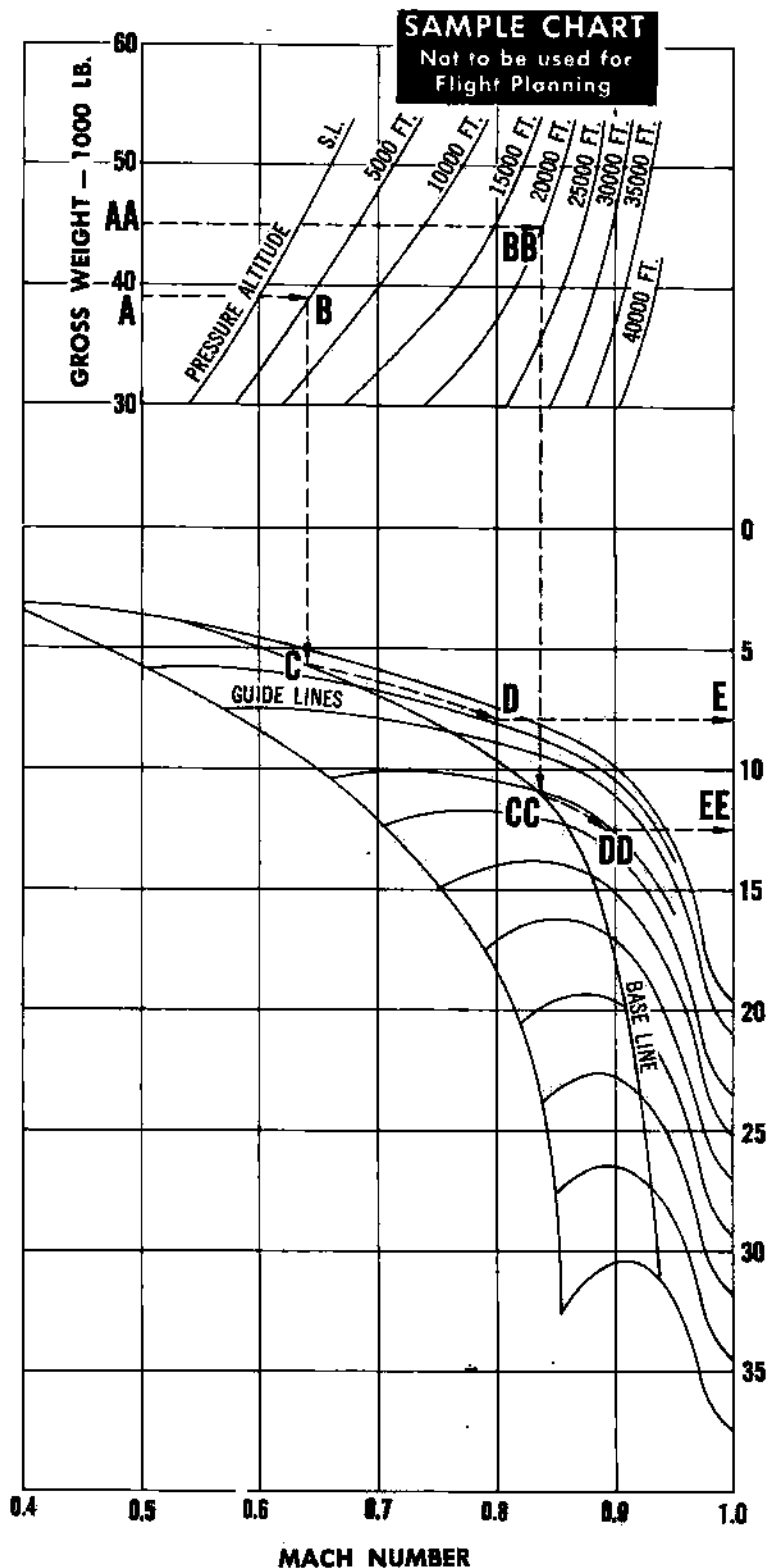
An alternate method can be used to determine the time elapsed, and distance covered with 2000 lb of available fuel. Enter chart as in step 6 and proceed from (LL) across to the nautical miles per pound scale and read 0.088 NMi/lb. Multiplying the fuel available (2000 lb) by the NMi/lb (0.088) will give the zero-wind distance. $2000 \times 0.088 = 176 \text{ NMi}$. To correct for wind use the following relationship:

Distance with wind = $\frac{\text{(zero-wind distance)}}{\text{TAS} \pm \text{Wind Speed}}$, where a tail wind is a

positive wind speed and a headwind is a negative speed. Distance with 50 knot headwind

= $176 \frac{(500-50)}{500} = 158 \text{ N.Mi.}$

**SPECIFIC RANGE
CRUISE FACTOR FOR NAUTICAL
MILES PER POUND OF FUEL**



Note (continued)

Time = Distance with Wind/speed with
wind = $158/(500-50) = 0.351$ Hr.
 0.351 Hr. X 60 = 21 Min.

SPECIFIC RANGE CHARTS

Nautical miles per pound of fuel, true airspeed and fuel flow can be read from these charts for any Configuration Drag Index for any conditions of Gross Weight, Pressure Altitude, Mach number and Ambient Temperature.

EXAMPLE I

Conditions: Configuration: Clean Aircraft
Initial Gross Weight: 40,000 lb
Cruise Altitude: 5000 ft
Cruise Speed: 490 KCAS
Ambient Temperature: 5°C colder than standard day

Find: Average Nautical Miles per pound of fuel, fuel flow and fuel used during a 10 minute cruise.

Solution:

1. From figure B4-1 determine Mach number at 5000 ft for 490 KCAS = 0.8 Mach number.
2. Determine standard day ambient temperature at 5000 ft pressure altitude from Standard Atmosphere Table figure B1-10 = 5.094°C.
Ambient temperature = Standard -5° = 5.094-5.0 = 0.09°C
3. Estimate Average Gross Weight
Initial Gross Weight = 40,000 lb
Estimated fuel used = 2000 lb
Estimated Final Gross Weight = 38,000 lb
Estimated Average
Gross Weight = $\frac{40,000 + 38,000}{2} = 39,000$ lb
4. Enter sample chart page B4-10 at estimated average gross weight of 39,000 lb, (A) and move to the right to 5000 ft altitude line, (B), then drop to base line, (C).
5. Follow guide line to Cruise Mach number = 0.80, (D).
6. Move to the right and read Cruise Factor - Clean Configuration = 7.9, (E).

7. Since no external stores are carried, go directly to the "Nautical miles per Pound of Fuel and Fuel Flow Chart." Enter chart page B4-12 at lower left hand corner at Cruise Mach number = 0.80, (F).

8. Move to the right to the Cruise Factor = 7.9 (G).

9. Move up to Cruise Altitude = 5000 ft, (H).

10. Move to the right to read nautical miles per pound of fuel from scale = 0.0622, (J).

11. Enter chart at Mach number = 0.8 at (L) and intersect the ambient temperature = 0°C at (M). Enter chart at nautical miles per pound of fuel = 0.0622 at (K) and draw a horizontal line.

12. Move upward from (M) to intersect line at (N) and read fuel flow = 8250 pounds per hour.

13. Compute fuel required for 10 minute cruise:
$$\frac{\text{time (min)}}{60 \text{ (min)}} \times \text{fuel flow } \frac{\text{lb}}{\text{hr}} = \text{fuel used.}$$

$$\frac{10 \times 8250}{60} = 1375 \text{ lb}$$

14. Revise Estimated Average Gross Weight
Initial Gross Weight = 40,000 lb
Computed Fuel Used = 1375 lb
Final Gross Weight = 38,625 lb
Average Gross
Weight = $\frac{40,000 + 38,625}{2} = 39,313$ lb

15. Reworking steps 4 thru 10 with revised average gross weight = 39,313 lb
Nautical Miles per pound of fuel is read as 0.0615 and fuel flow as 8300 lb/hr
Fuel used for cruise = $\frac{10 \times 8300}{60} = 1383$

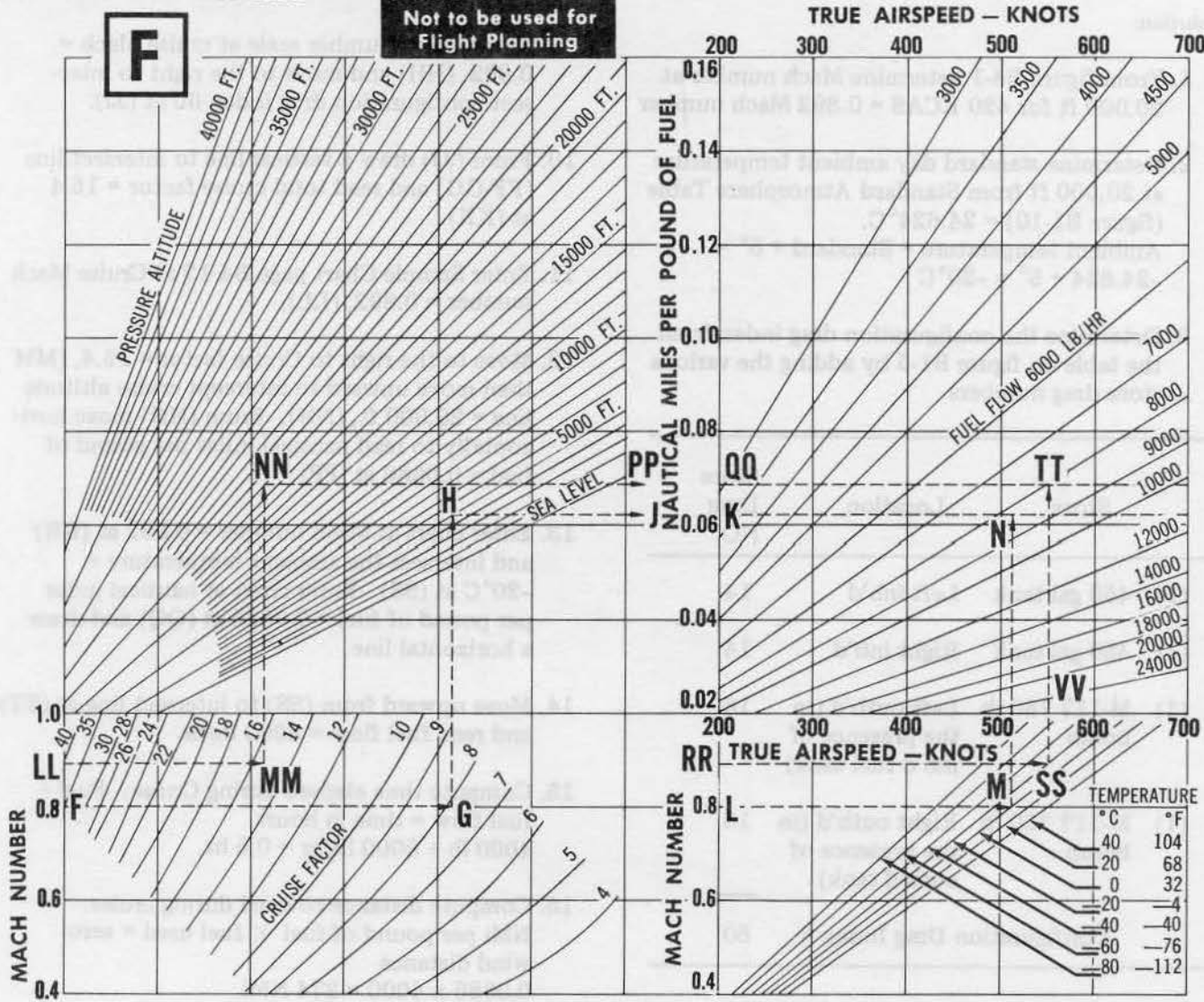
EXAMPLE II

Conditions: Configuration: Clean + (2) 450 gal tanks (inboard) + (2) M-117 750 lb bombs (outb'd)
Initial Gross Weight: 47,000 lb
Cruise Altitude: 20,000 ft
Cruise Speed: 420 KCAS
Ambient Temperature: Standard Day + 5°C

Find: Time elapsed, zero-wind distance covered, average fuel flow and nautical miles per pound of

**SPECIFIC RANGE
NAUTICAL MILES PER POUND
OF FUEL AND FUEL FLOW**

SAMPLE CHART
Not to be used for
Flight Planning



fuel, having available 4000 lb of fuel for cruise at constant altitude.

Solution:

1. From figure B4-1 determine Mach number at 20,000 ft for 420 KCAS = 0.892 Mach number
2. Determine standard day ambient temperature at 20,000 ft from Standard Atmosphere Table (figure B1-10) = 24.624°C .
Ambient temperature = Standard + 5° = $-24.624 + 5^{\circ} = -20^{\circ}\text{C}$
3. Determine the configuration drag index from the table on figure B1-5 by adding the various store drag numbers

Store	Location	Store Drag NO.
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb'd	14
(1) M-117 750 lb bomb	Left outb'd (in the presence of inb'd fuel tank)	16
(1) M-117 750 lb bomb	Right outb'd (in the presence of outb'd tank)	16
Configuration Drag Index =		60

4. Compute Average Gross Weight
Initial Gross Weight = 47,000 lb
Fuel Used for Cruise = 4000 lb
Final Gross Weight = 43,000 lb
Average Gross Weight = $\frac{47,000 + 43,000}{2} = 45,000$ lb
5. Enter sample chart page B4-10 at average gross weight = 45,000 lb, (AA), and move to the right to 20,000 ft altitude line, (BB), then drop down to base line, (CC).
6. Follow guide line to Cruise Mach number = 0.892, (DD).
7. Move to the right and read Cruise Factor — Clean Configuration = 12.5, (EE).

8. Enter Sample Chart page B4-10 at Cruise Factor — Clean Configuration = 12.5 (FF) and draw a horizontal line (FF-GG).

9. Enter Mach Number scale at cruise Mach = 0.892, (HH) and move to the right to intersect configuration drag index 60 at (JJ).
10. From (JJ) draw a vertical line to intersect line (FF-GG) and read total cruise factor = 15.4 at (KK).
11. Enter Sample Chart page B4-12 at Cruise Mach number = 0.892, (LL).
12. Move to the right to Cruise factor = 15.4, (MM) then move upward to intercept cruise altitude line = 20,000 ft, (NN). From (NN) move horizontally to read nautical miles per pound of fuel = 0.0686 at (PP).
13. Enter chart at Mach number = 0.892 at (RR) and intersect the ambient temperature = -20°C at (SS). Enter chart at nautical miles per pound of fuel = 0.0686 at (QQ) and draw a horizontal line.
14. Move upward from (SS) to intersect line at (TT) and read fuel flow = 8000 lb/hr.
15. Compute time elapsed during Cruise: Fuel $\div$ fuel flow = time in hours
 $4000 \text{ lb} \div 8000 \text{ lb/hr} = 0.5 \text{ hr}$.
16. Compute distance covered during cruise:
NMI per pound of fuel $\times$ fuel used = zero-wind distance
 $0.0686 \times 4000 = 274 \text{ NMI}$

Note

To correct distance for prevailing winds use the following relationship.
Distance with wind = (zero-wind distance) $\frac{(\text{TAS} \pm \text{Wind Speed})}{\text{TAS}}$

where a tailwind is a positive wind speed and a headwind is a negative speed.

Examples: To correct the no-wind distance of 274 NMI (computed in step 16) for a prevailing headwind of 20 knots, read true airspeed = 552 knots at (UU).

Then, $(274 \text{ NMI}) \frac{(552 - 20)}{552} =$

264 NMI with 20 knot headwind

DIVERSION SUMMARY TABLES

Diversion Range and Diversion Endurance Summary Tables are each presented for four configuration drag indices. Since the variation between adjacent configurations is small, the chart which comes closest in drag index to the configuration flown may be used.

These tables are provided to determine range (or time) available with various values of fuel remaining. Included in the range charts are four flight profiles, as follows:

- (A) Cruise at initial altitude until over base. Time and fuel are included for a penetration descent at destination, but range does not include descent distance.
- (B) Cruise at initial altitude and descend on course. Time and fuel are included for a maximum range descent at destination and range includes the on-course descent distance.
- (C) Use optimum altitude over base. Time and fuel are included for a Military Thrust climb to optimum altitude and a penetration descent at destination. Range includes on-course climb distance but does not include descent distance.
- (D) Use optimum altitude and descend on course. Time and fuel are included for a Military Thrust climb to optimum altitude and a maximum range descent at destination. Range includes both the on-course climb and descent distances.

The endurance charts show flight time available at speeds for maximum endurance for the following two profiles:

- (A) Loiter at initial altitude. Time and fuel included for a maximum range descent to sea level destination.
- (B) Climb to and loiter at optimum altitude. Time and fuel included for both a Military Thrust climb to optimum altitude and a maximum range descent to sea level destination.

Sample Problem

Given:

Clean aircraft [947] C/W plus (2) 450-gallon tanks with 3000 lbs of fuel on board at 15,000 feet pressure altitude.

- Find: (a) Zero wind distance available at optimum altitude.
- (b) Zero wind endurance time at optimum altitude.

Solution:

- Determine the configuration drag index from figure A1-5 by adding the various store drag numbers.

	Store Drag NO.
Clean Aircraft [947] C/W	20
(1) 450 gal tank, right inb'd	14
(1) 450 gal tank, left inb'd	14
Configuration Drag Index =	48

The chart closest to a configuration index of 48 is the one for configuration drag index = 42.

- Enter Diversion Range Summary Chart for drag index of 42 (page B4-26) at initial altitude of 15,000 feet and 3000 lbs of fuel onboard, and read:
 - (a) For profile (C), climb to 25,000 feet to realize a 146 nautical mile zero-wind range over destination and arrive at sea level destination with 1000 lb approach and landing reserve. Flight time is 22.8 minutes. Cruise speed at 25,000 feet is shown at the bottom of the chart to be 0.81 Mach.
 - (b) For profile (D), climb to 35,000 feet to realize a 235 nautical mile zero-wind range, of which 60 nautical miles is the maximum range descent distance to sea level destination, and arrive with 1000 lb approach and landing reserve. Flight time is 30.6 minutes and cruise speed is 0.87 Mach.
- Enter Diversion Endurance Summary Chart for drag index of 42 (page B4-30) at initial altitude of 15,000 feet and 3000 lbs of fuel on board. For profile (B), climb to 25,000 feet to realize 31.8 minutes in flight, of which 7.5 minutes is the maximum range descent time to sea level destination, and arrive with 1000 lb approach and landing reserve. Loiter at 25,000 feet at 0.68 Mach number.

MACH NUMBER — CALIBRATED AIRSPEED CHART

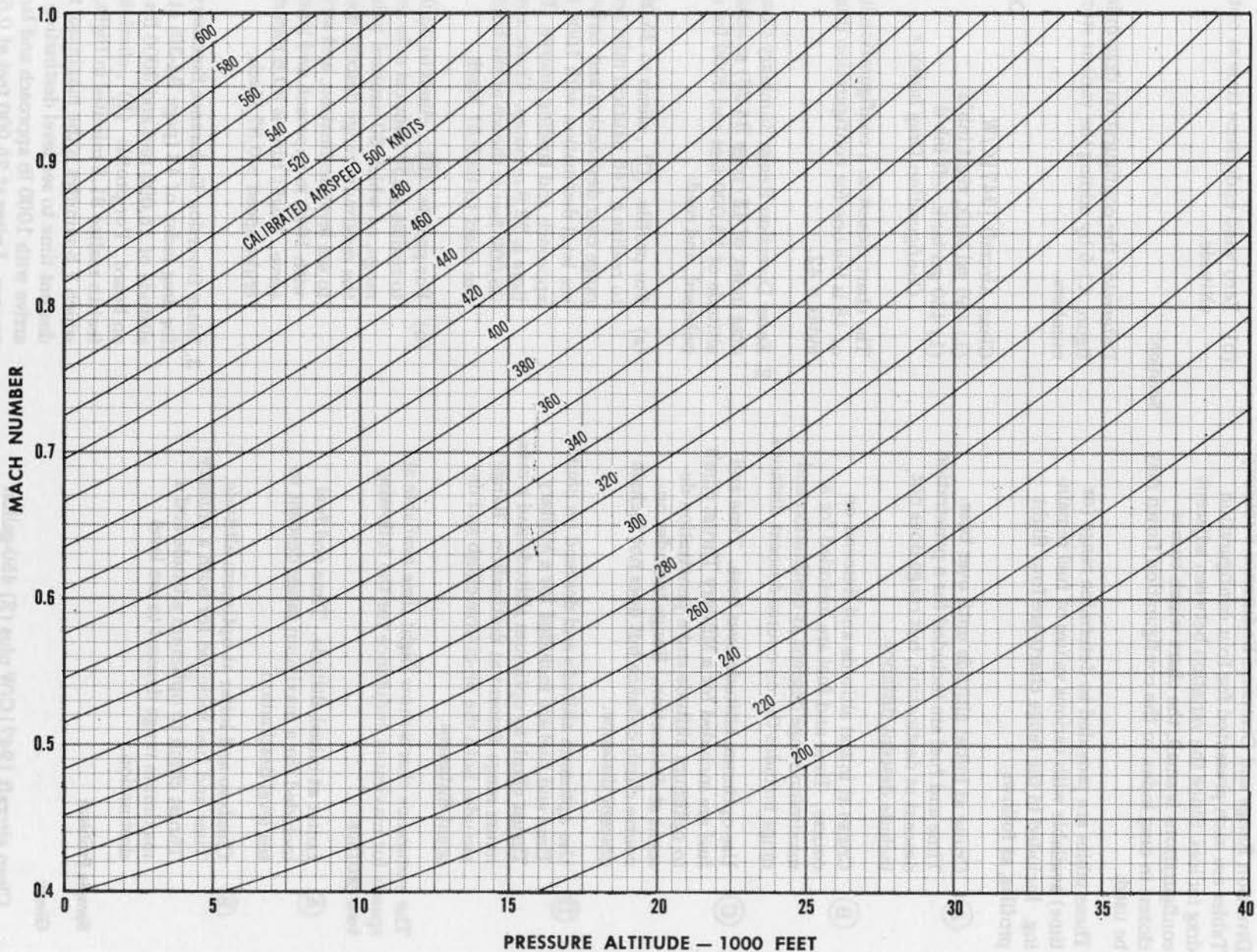


Figure B4-1

CONSTANT ALTITUDE LONG RANGE CRUISE MACH NUMBER AND TIME

Model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

F

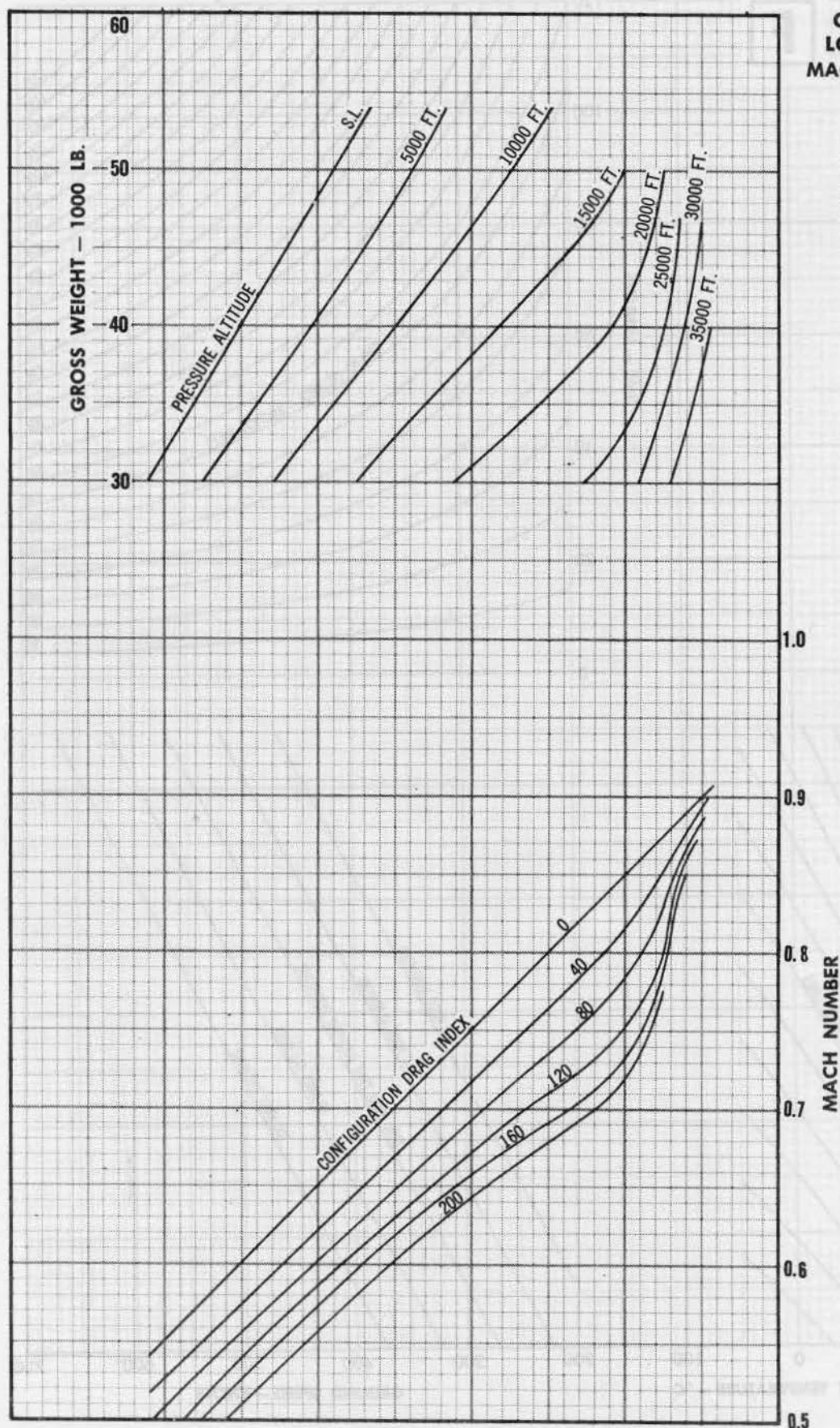


Figure B4-2 (Sheet 1 of 3)

CONSTANT ALTITUDE
LONG RANGE CRUISE
MACH NO. AND TIME

model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

PRESSURE ALTITUDE 1000 FT	STD DAY TEMP °C
0	15
5	5
10	-5
15	-15
20	-25
25	-35
30	-44
35	-54
40	-57

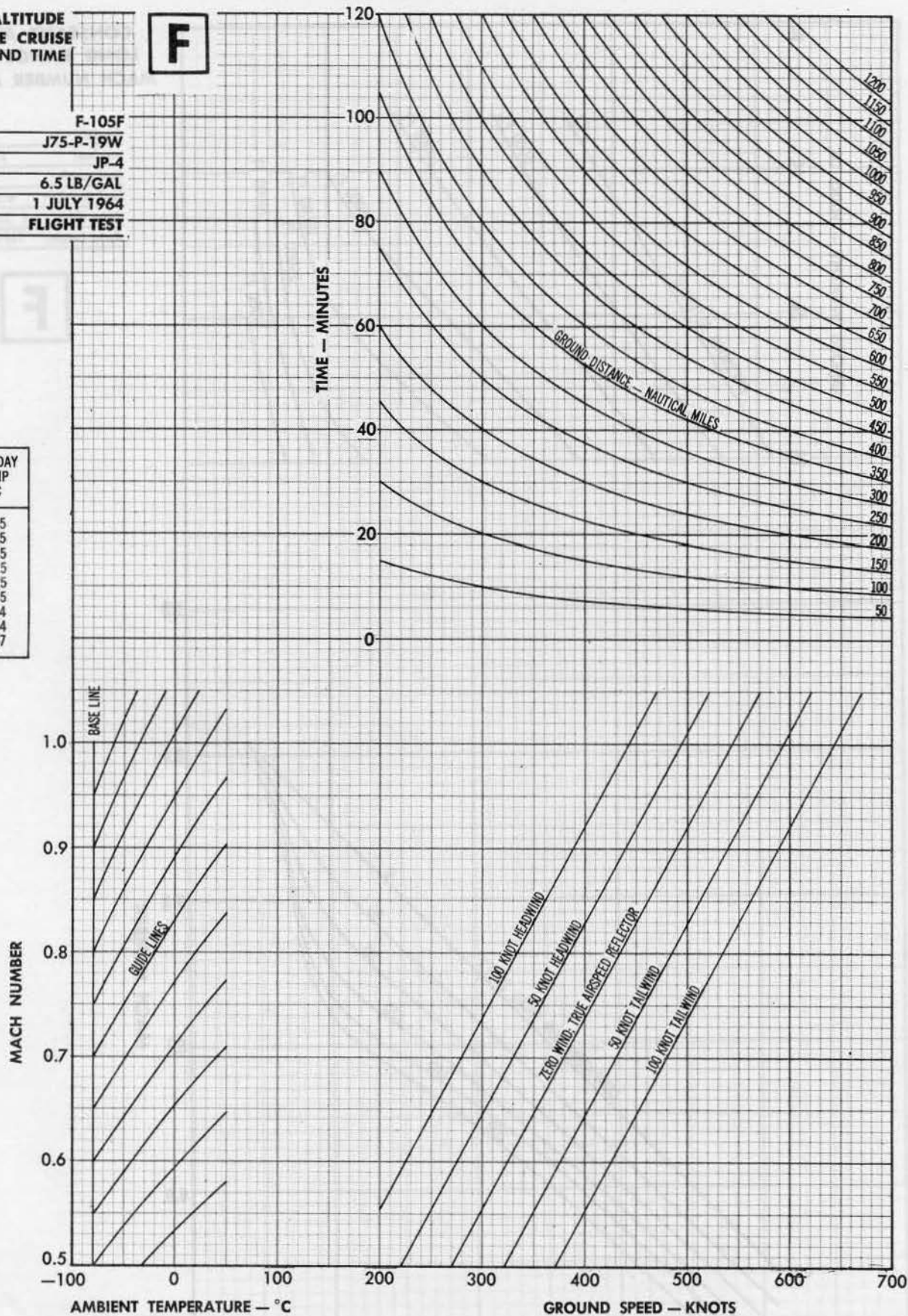


Figure B4-2 (Sheet 2 of 3)

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST



**CONSTANT ALTITUDE
 LONG RANGE CRUISE
 NAUTICAL MILES PER POUND
 OF FUEL, FUEL FLOW
 AND FUEL USED**

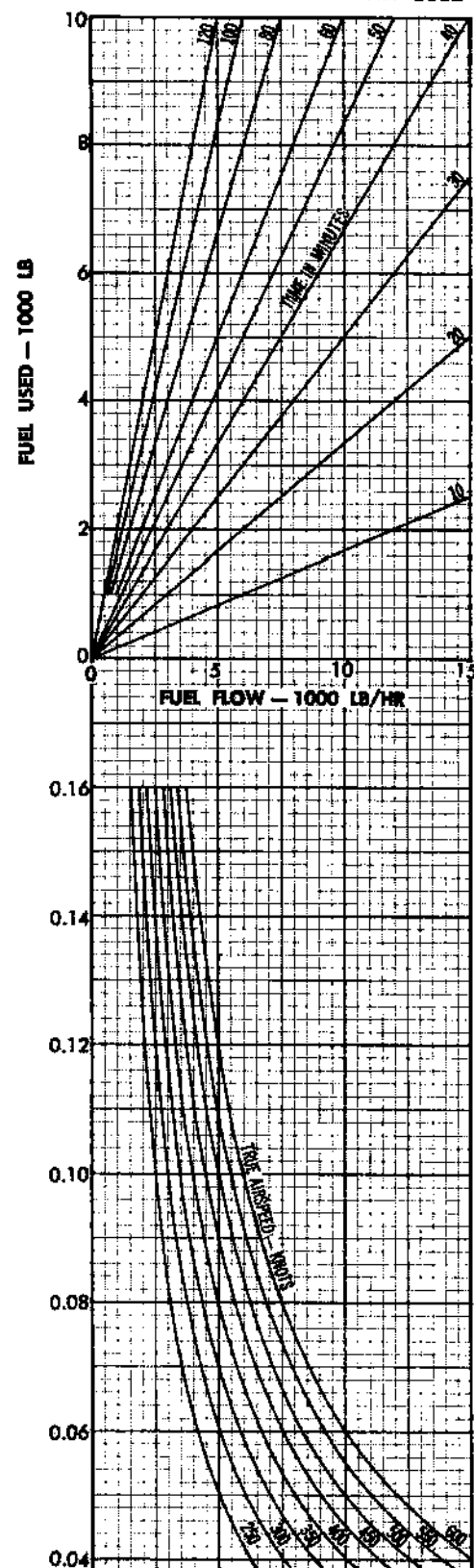
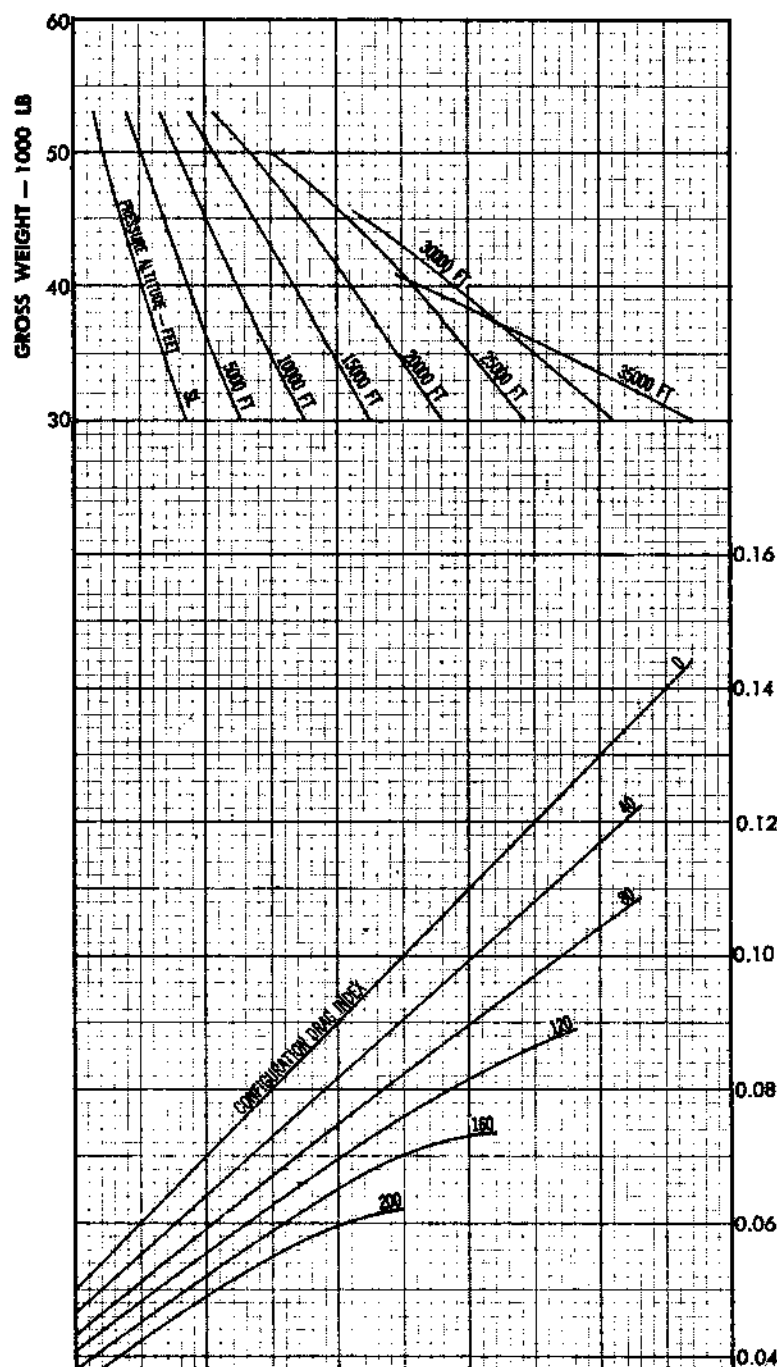


Figure B4-2 (Sheet 3 of 3)

CRUISE CLIMB PERFORMANCE
CRUISE ALTITUDE, MACH NUMBER AND TIME
F

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

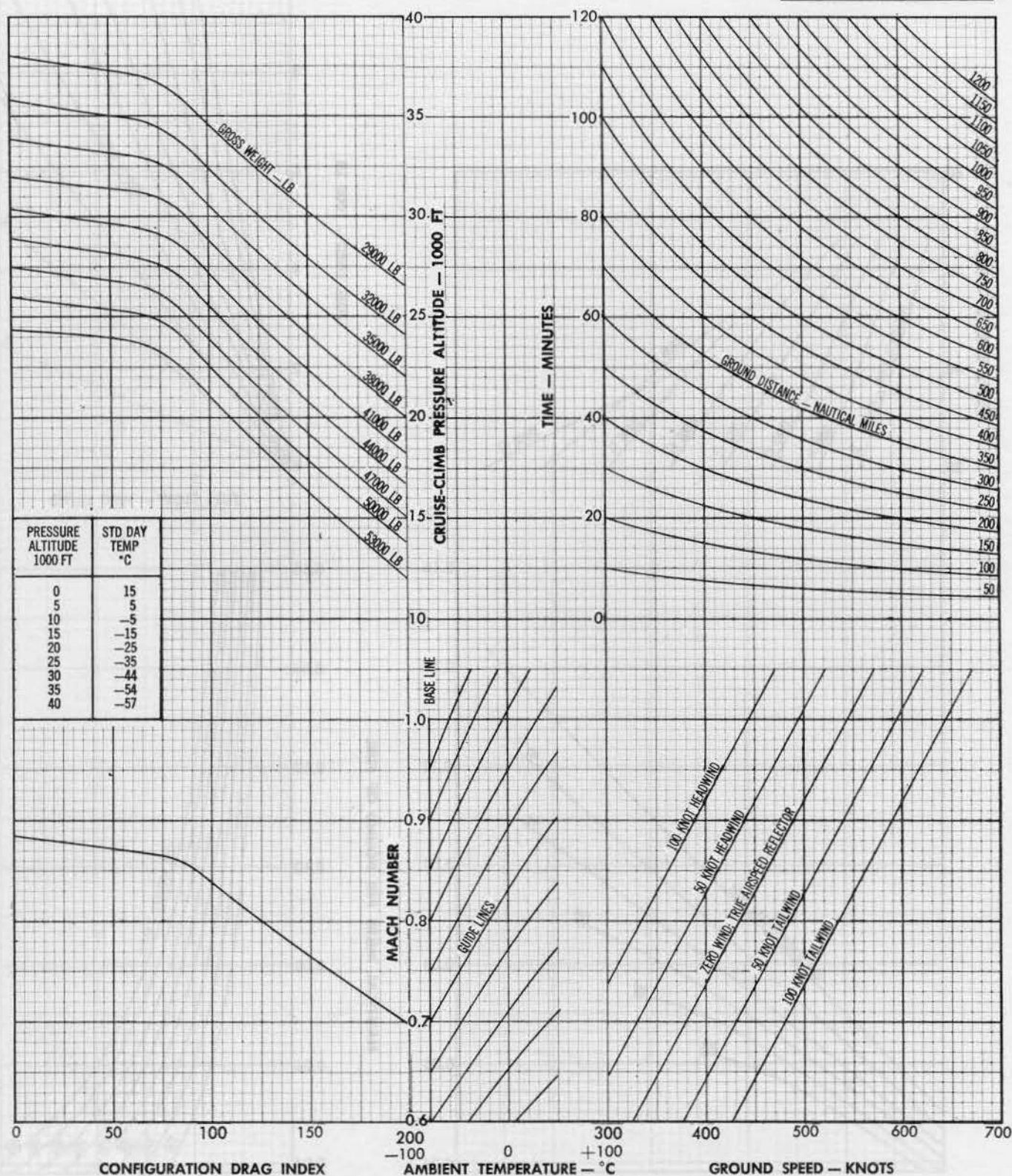
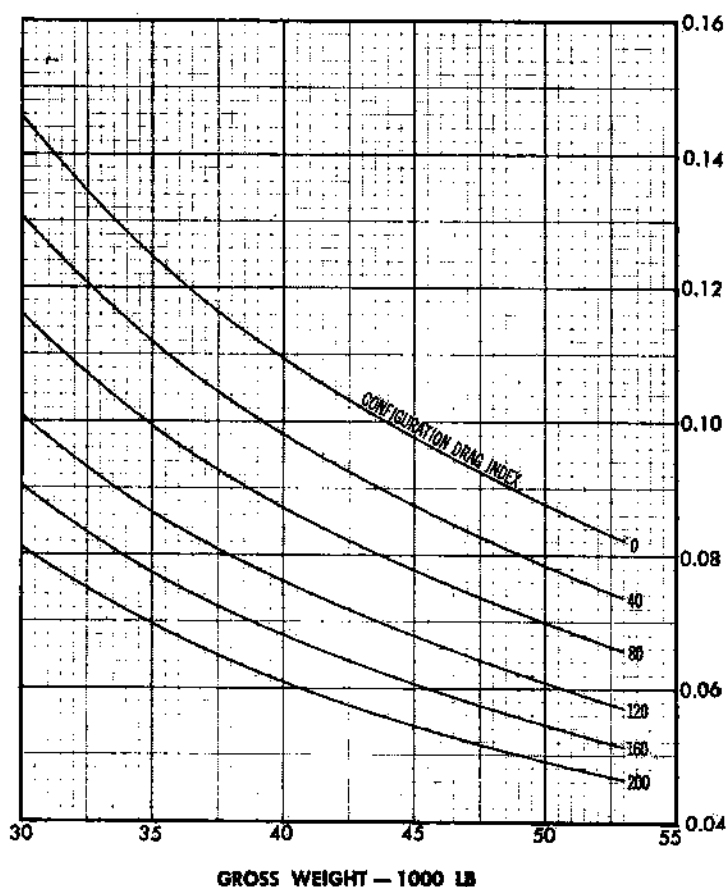
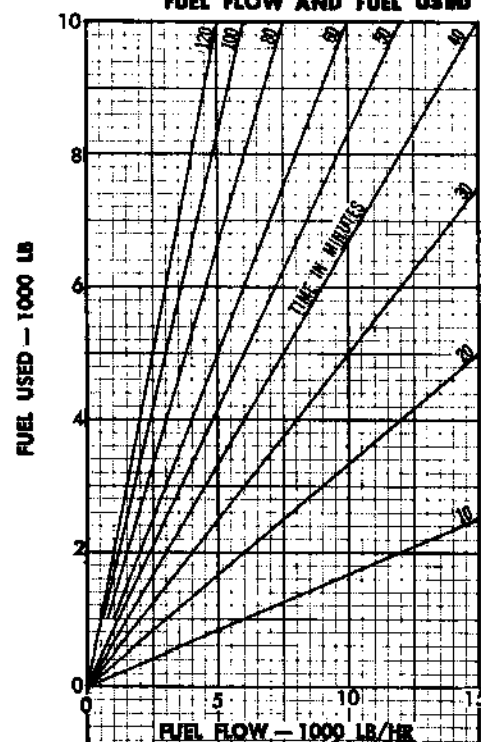


Figure B4-3 (Sheet 1 of 2)

model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

F

CRUISE CLIMB PERFORMANCE
NAUTICAL MILES PER POUND OF FUEL
FUEL FLOW AND FUEL USED



NAUTICAL MILES PER POUND OF FUEL

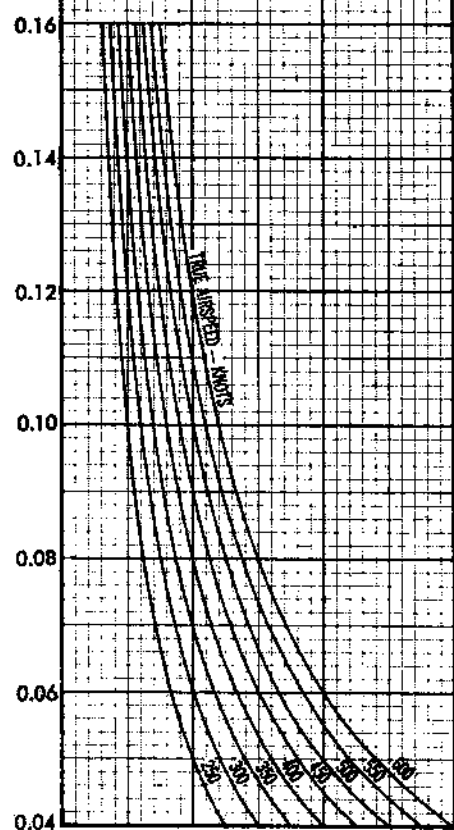


Figure B4-3 (Sheet 2 of 2)

**SPECIFIC RANGE
CRUISE FACTOR FOR
NAUTICAL MILES
PER POUND OF FUEL**

F

model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

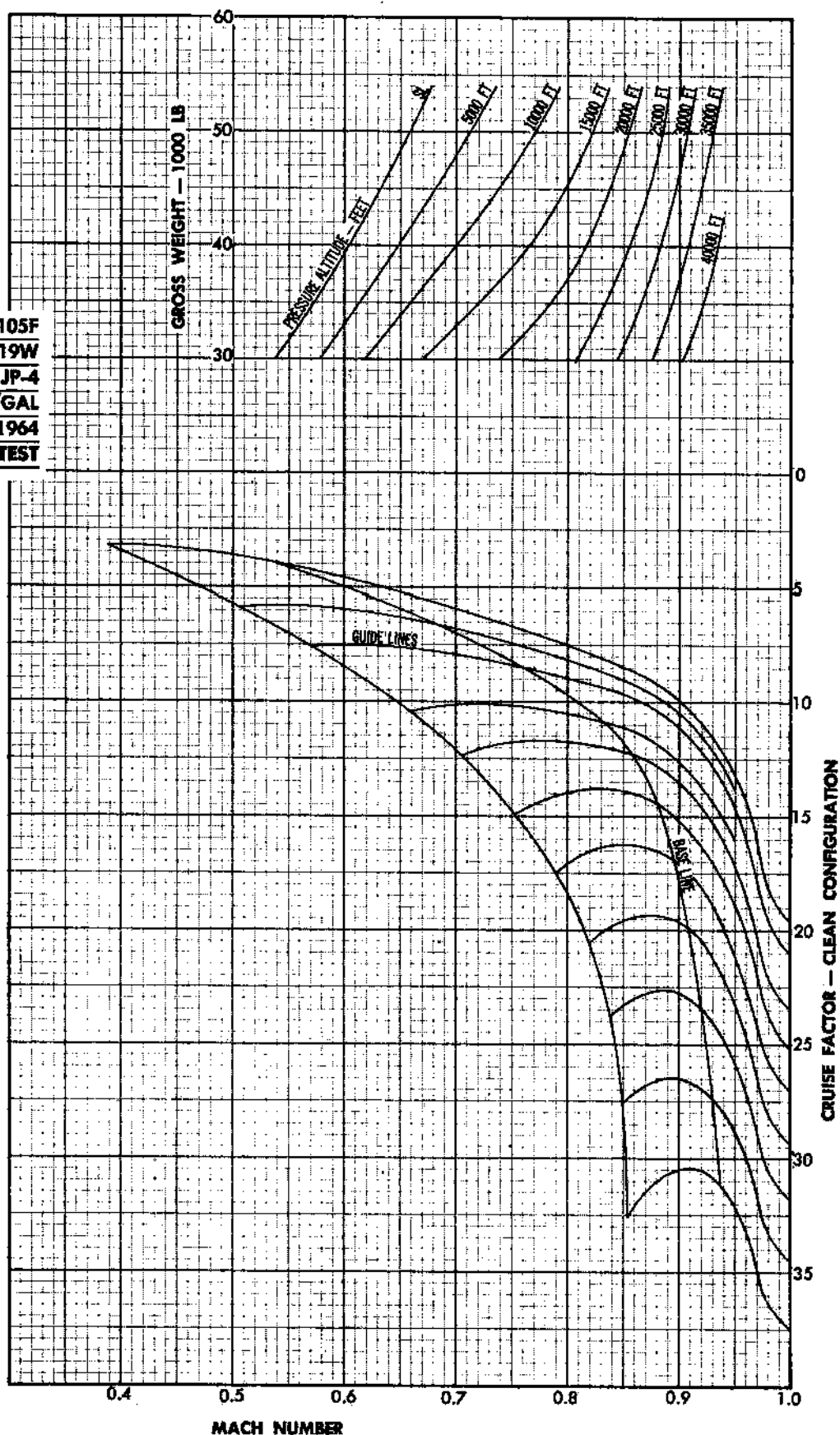


Figure B4-4 (Sheet 1 of 4)

SPECIFIC RANGE
CRUISE FACTOR FOR NAUTICAL
MILES PER POUND OF FUEL

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

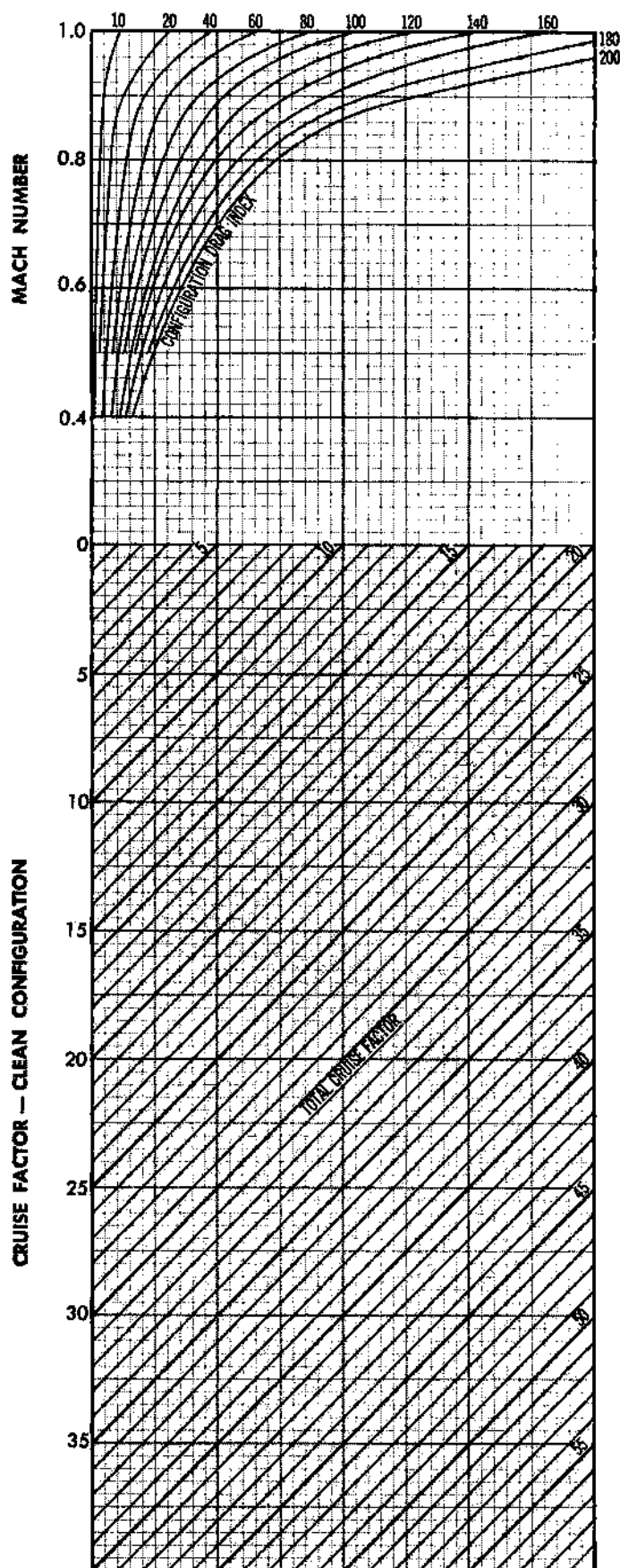


Figure B4-4 (Sheet 2 of 4)

SPECIFIC RANGE
NAUTICAL MILES PER POUND
OF FUEL AND FUEL FLOW

F

Model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

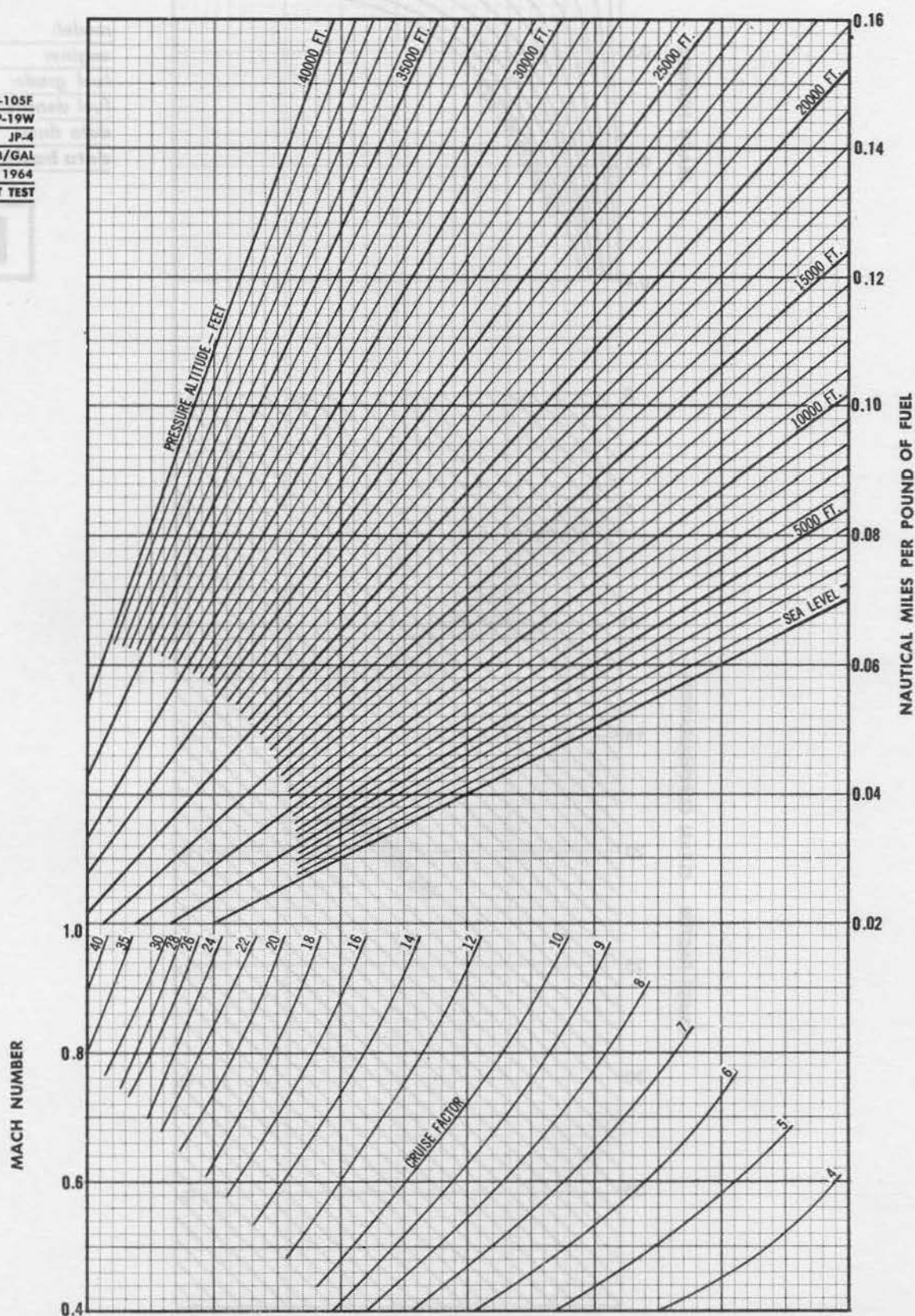
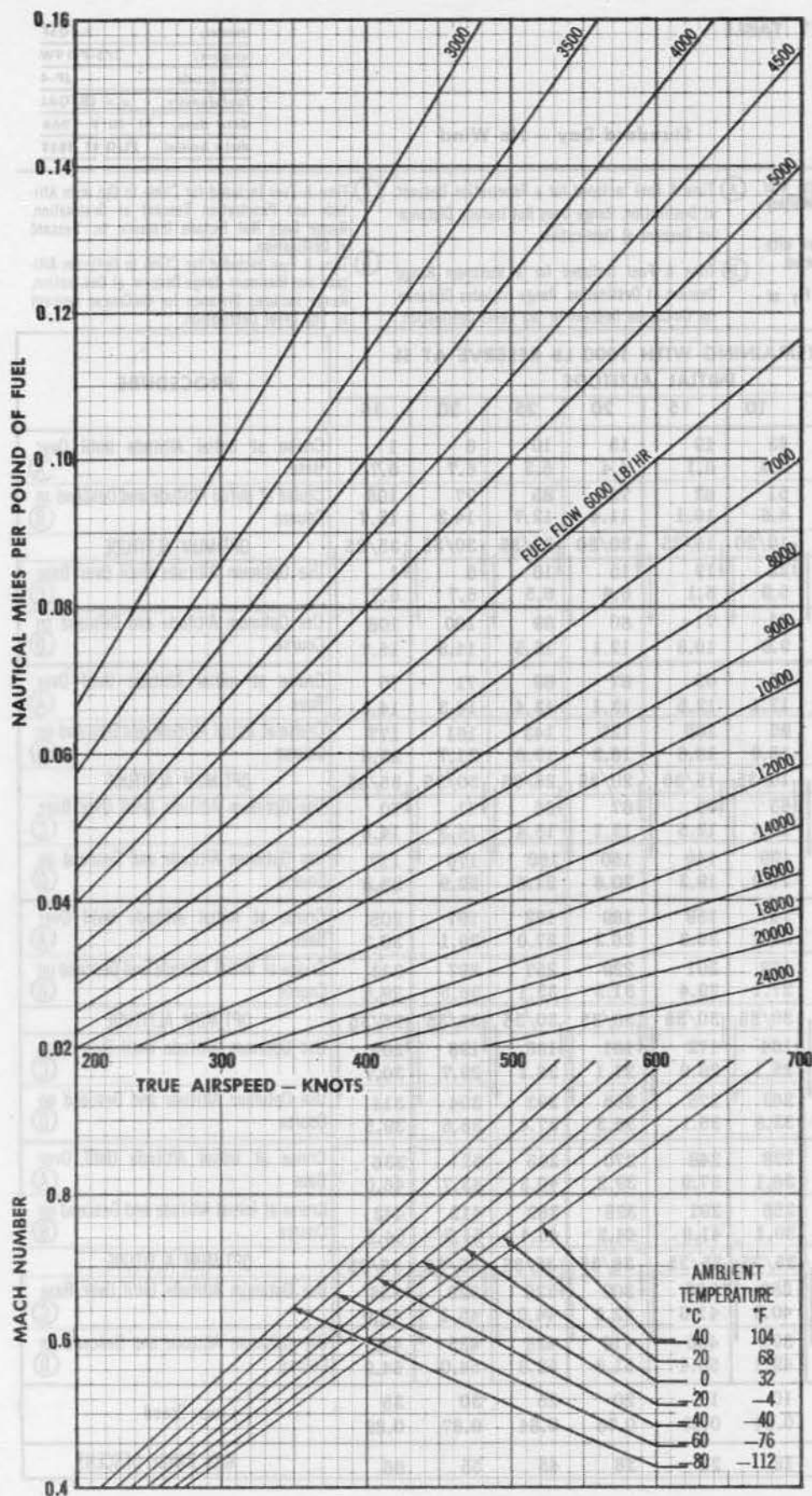


Figure B4-4 (Sheet 3 of 4)



SPECIFIC RANGE **NAUTICAL MILES PER POUND** **OF FUEL AND FUEL FLOW**

Model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

F

PRESSURE ALTITUDE 1000 FT	STD DAY TEMP °C
0	15
5	5
10	-5
15	-15
20	-25
25	-35
30	-44
35	-54
40	-57

Figure B4-4 (Sheet 4 of 4)

DIVERSION RANGE SUMMARY TABLE



Standard Day — No Wind

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JU Y 1964
 data basis: FLIGHT TEST

Climb Speed Schedule and Thrust Settings: 400 KCAS to Recommended Mach Number with Military Thrust.

* Schedules Provide For Arrival at Sea Level with 1000 LB Fuel — Approach and Landing Reserve.

With Over 3500 LB of Fuel Remaining, Fly at 35000 FT at M 0.89 for Optimum Range.

(A) Time & Fuel Included for a Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(B) Time & Fuel Included for a Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

(C) Time & Fuel Included for Climb to Optimum Altitude and Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(D) Time & Fuel Included for Climb to Optimum Altitude and Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

*TOTAL FUEL ON BOARD LB	RANGE AND TIME REMAINING WITH 1000 LB RESERVE AT SL									PROCEDURE
	INITIAL ALTITUDE									
	1000 FT	SL	5	10	15	20	25	30	35	
1500	NAUT MI	33	27	23	19	15	10	6	1	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	5.4	5.6	5.9	6.1	6.4	6.5	6.7	6.7	
	NAUT MI	33	43	51	62	73	85	97	108	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	5.4	7.2	8.6	10.1	11.4	12.7	14.2	15.7	
	1000 FT	SL/10	5/15	10/20	15/25	20/30	25/35	30/35	35/35	OPTIMUM ALTITUDE
	NAUT MI	33	27	23	19	15	10	6	1	Use Optimum Altitude Until Over Base (C)
2000	MINUTES	5.4	5.6	5.9	6.1	6.4	6.5	6.7	6.7	
	NAUT MI	40	49	61	71	80	89	100	108	Use Optimum Altitude and Descend on Course (D)
	MINUTES	6.4	8.0	9.6	10.8	12.1	13.5	14.8	15.7	
	NAUT MI	66	64	65	65	67	68	71	70	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	10.9	11.4	12.1	12.5	13.1	13.4	14.3	14.8	
	NAUT MI	66	80	95	109	125	143	161	177	Cruise at Initial Altitude and Descend on Course (B)
3000	MINUTES	10.9	13.0	15.0	16.6	18.2	19.6	21.7	23.8	
	1000 FT	SL/30	5/35	10/35	15/35	20/35	25/35	30/35	35/35	OPTIMUM ALTITUDE
	NAUT MI	66	64	65	65	67	68	71	70	Use Optimum Altitude Until Over Base (C)
	MINUTES	10.9	11.4	12.1	12.5	13.1	13.4	14.3	14.8	
	NAUT MI	100	115	129	140	150	160	170	177	Use Optimum Altitude and Descend on Course (D)
	MINUTES	14.2	16.4	17.9	19.3	20.6	21.6	22.9	23.8	
4000	NAUT MI	131	137	147	158	169	182	197	205	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	21.6	23.0	24.2	25.3	26.2	27.0	29.1	30.7	
	NAUT MI	131	154	178	201	229	257	287	311	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	21.6	24.6	27.1	29.4	31.3	33.1	36.5	39.5	
	1000 FT	25/35	25/35	30/35	30/35	30/35	30/35	35/35	35/35	OPTIMUM ALTITUDE
	NAUT MI	138	150	164	172	181	188	198	205	Use Optimum Altitude Until Over Base (C)
4000	MINUTES	21.3	22.8	25.1	26.0	27.1	28.1	29.7	30.7	
	NAUT MI	235	251	263	275	285	293	304	311	Use Optimum Altitude and Descend on Course (D)
	MINUTES	30.2	32.2	33.8	35.1	36.3	37.4	38.6	39.5	
	NAUT MI	196	210	228	248	270	295	321	336	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	32.3	34.3	36.1	37.9	39.2	40.3	43.7	46.0	
	NAUT MI	196	226	258	291	328	369	412	442	Cruise at Initial Altitude and Descend on Course (B)
4000	MINUTES	32.3	35.9	39.1	41.8	44.2	46.4	51.2	54.9	
	1000 FT	35/35	35/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
	NAUT MI	260	276	289	300	309	320	329	336	Use Optimum Altitude Until Over Base (C)
	MINUTES	36.8	38.6	40.3	41.6	42.6	44.0	45.1	46.0	
	NAUT MI	366	381	395	406	416	425	435	442	Use Optimum Altitude and Descend on Course (D)
	MINUTES	45.6	47.4	49.1	50.4	51.6	52.8	54.0	54.9	
Cruise Altitude		SL	5	10	15	20	25	30	35	Cruise Speed
True Mach No		0.55	0.59	0.64	0.69	0.76	0.84	0.87	0.89	
DESCENT DIST NAUT MI -		9	18	26	36	45	55	66	MAX RANGE DESCENT	

Figure B4-5 (Sheet 1 of 4)

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

DIVERSION RANGE SUMMARY TABLE

CONFIGURATION
DRAG INDEX ► 28**F**

Standard Day — No Wind

Climb Speed Schedule and Thrust Settings: 400 KCAS to Recommended Mach Number with Military Thrust.

* Schedules Provide For Arrival at Sea Level with 1000 LB Fuel — Approach and Landing Reserve.

With Over 3500 LB of Fuel Remaining, Fly at 35000 FT at M 0.88 for Optimum Range.

(A) Time & Fuel Included for a Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(B) Time & Fuel Included for a Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

(C) Time & Fuel Included for Climb to Optimum Altitude and Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(D) Time & Fuel Included for Climb to Optimum Altitude and Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

*TOTAL FUEL ON BOARD LB	RANGE AND TIME REMAINING WITH 1000 LB RESERVE AT SL									PROCEDURE
		INITIAL ALTITUDE								
	1000 FT	SL	5	10	15	20	25	30	35	
1500	NAUT MI	31	25	22	19	15	11	7	3	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	5.2	5.4	5.7	6.0	6.2	6.3	6.5	6.8	
	NAUT MI	31	40	50	59	70	79	91	101	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	5.2	6.8	8.4	9.6	10.9	12.1	13.6	14.8	
	1000 FT	SL/10	5/15	10/20	15/20	20/25	25/30	30/35	35/35	OPTIMUM ALTITUDE
2000	NAUT MI	31	25	22	19	15	11	7	3	Use Optimum Altitude Until Over Base (C)
	MINUTES	5.2	5.4	5.7	6.0	6.2	6.3	6.5	6.8	
	NAUT MI	35	46	54	60	72	82	97	101	Use Optimum Altitude and Descend on Course (D)
	MINUTES	6.0	7.4	8.8	9.5	11.3	12.5	14.2	14.8	
	1000 FT	SL/25	5/30	10/30	15/35	20/35	25/35	30/35	35/35	OPTIMUM ALTITUDE
3000	NAUT MI	61	60	61	62	63	64	66	66	Use Optimum Altitude Until Over Base (C)
	MINUTES	10.3	11.0	11.6	12.1	12.5	12.8	13.6	14.2	
	NAUT MI	80	95	107	123	137	148	159	164	Use Optimum Altitude and Descend on Course (D)
	MINUTES	12.5	14.2	15.7	17.4	19.1	20.1	21.6	22.3	
	1000 FT	SL/35	15/35	20/35	25/35	30/35	30/35	30/35	35/35	OPTIMUM ALTITUDE
4000	NAUT MI	122	128	137	147	157	169	182	187	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	20.6	21.9	23.2	24.1	24.9	25.6	27.6	28.7	
	NAUT MI	122	142	165	188	212	237	265	285	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	20.6	23.2	25.8	27.9	29.6	31.4	34.5	36.7	
	1000 FT	SL/35	15/35	20/35	25/35	30/35	30/35	30/35	35/35	OPTIMUM ALTITUDE
5000	NAUT MI	124	132	140	150	164	173	182	187	Use Optimum Altitude Until Over Base (C)
	MINUTES	20.7	22.0	22.6	23.4	25.2	26.4	27.6	28.7	
	NAUT MI	204	217	232	246	260	269	279	285	Use Optimum Altitude and Descend on Course (D)
	MINUTES	27.3	29.3	30.4	32.1	33.6	34.6	36.0	36.7	
	1000 FT	SL/35	15/35	20/35	25/35	30/35	30/35	30/35	35/35	OPTIMUM ALTITUDE
6000	NAUT MI	182	195	213	231	250	272	295	305	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	30.7	32.7	34.7	36.1	37.1	38.2	41.2	42.7	
	NAUT MI	182	209	240	272	305	340	378	403	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	30.7	33.9	37.2	39.8	41.9	44.0	48.1	50.8	
	1000 FT	SL/35	15/35	20/35	25/35	30/35	30/35	30/35	35/35	OPTIMUM ALTITUDE
7000	NAUT MI	226	239	252	267	278	287	300	305	Use Optimum Altitude Until Over Base (C)
	MINUTES	33.1	34.6	36.4	38.0	39.3	40.5	42.0	42.7	
	NAUT MI	322	338	350	369	376	385	398	403	Use Optimum Altitude and Descend on Course (D)
	MINUTES	41.3	43.0	44.5	46.0	47.3	48.5	50.1	50.8	
	1000 FT	SL/35	15/35	20/35	25/35	30/35	30/35	30/35	35/35	OPTIMUM ALTITUDE
Cruise Altitude		SL	5	10	15	20	25	30	35	Cruise Speed
True Mach No		0.54	0.58	0.62	0.68	0.74	0.82	0.85	0.88	
DESCENT DIST NAUT MI		8	16	25	34	42	52	63	MAX RANGE DESCENT	

Figure B4-5 (Sheet 2 of 4)

DIVERSION RANGE SUMMARY TABLE

CONFIGURATION
DRAG INDEX

► 42

Standard Day — No Wind

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

Climb Speed Schedule and Thrust Settings: 400 KCAS to Recommended Mach Number with Military Thrust.

* Schedules Provide For Arrival at Sea Level with 1000 LB Fuel — Approach and Landing Reserve.

With Over 3500 LB of Fuel Remaining, Fly at 35000 FT at M 0.87 for Optimum Range.

(A) Time & Fuel Included for a Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(B) Time & Fuel Included for a Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

(C) Time & Fuel Included for Climb to Optimum Altitude and Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(D) Time & Fuel Included for Climb to Optimum Altitude and Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

TOTAL FUEL ON BOARD LB	RANGE AND TIME REMAINING WITH 1000 LB RESERVE AT SL									PROCEDURE
	1000 FT	INITIAL ALTITUDE								
		SL	5	10	15	20	25	30	35	
1500	NAUT MI	30	25	22	19	15	11	7	3	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	5.1	5.3	5.6	5.9	6.1	6.3	6.7	6.7	
	NAUT MI	30	38	48	57	67	78	88	98	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	5.1	6.5	8.2	9.4	10.7	11.8	13.2	14.4	
	1000 FT	SL/10	5/15	10/15	15/20	20/25	25/30	30/35	35/35	OPTIMUM ALTITUDE
2000	NAUT MI	30	25	22	19	15	11	7	3	Use Optimum Altitude Until Over Base (C)
	MINUTES	5.1	5.3	5.6	5.9	6.1	6.3	6.7	6.7	
	NAUT MI	34	44	51	59	70	79	93	98	Use Optimum Altitude and Descend on Course (D)
	MINUTES	5.9	7.4	8.4	9.4	10.9	12.0	13.9	14.4	
	1000 FT	SL/20	5/25	10/30	15/35	20/35	25/35	30/35	35/35	OPTIMUM ALTITUDE
3000	NAUT MI	60	58	59	60	61	62	64	63	Use Optimum Altitude Until Over Base (C)
	MINUTES	10.2	10.7	11.2	11.9	12.2	12.5	13.5	13.8	
	NAUT MI	76	89	102	118	130	141	153	157	Use Optimum Altitude and Descend on Course (D)
	MINUTES	11.9	13.4	15.0	16.8	18.2	19.4	20.8	21.4	
	1000 FT	SL/35	15/35	20/35	25/35	30/35	30/35	30/35	35/35	OPTIMUM ALTITUDE
4000	NAUT MI	118	124	133	142	152	163	174	178	Use Optimum Altitude Until Over Base (C)
	MINUTES	20.1	21.4	22.6	23.6	24.3	25.0	26.8	27.4	
	NAUT MI	118	137	159	181	204	230	254	273	Use Optimum Altitude and Descend on Course (D)
	MINUTES	20.1	22.5	25.2	27.1	28.9	30.6	33.3	35.2	
	1000 FT	SL/35	30/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
4000	NAUT MI	120	128	135	146	157	167	174	178	Use Optimum Altitude Until Over Base (C)
	MINUTES	20.1	21.4	21.8	22.8	24.7	25.8	26.8	27.4	
	NAUT MI	194	210	221	235	246	257	267	273	Use Optimum Altitude and Descend on Course (D)
	MINUTES	26.0	27.9	29.2	30.6	31.9	33.3	34.5	35.2	
	1000 FT	SL/35	30/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
4000	NAUT MI	176	190	207	224	242	262	283	290	Use Optimum Altitude Until Over Base (C)
	MINUTES	29.9	32.0	33.9	35.3	36.3	37.2	40.0	40.8	
	NAUT MI	176	203	232	263	293	329	363	385	Use Optimum Altitude and Descend on Course (D)
	MINUTES	29.9	33.2	36.4	38.8	40.7	42.8	46.5	48.6	
	1000 FT	SL/35	30/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
4000	NAUT MI	215	228	242	254	265	276	283	290	Use Optimum Altitude Until Over Base (C)
	MINUTES	31.8	33.4	35.0	36.4	37.7	38.9	40.0	40.8	
	NAUT MI	307	321	334	348	360	370	378	385	Use Optimum Altitude and Descend on Course (D)
	MINUTES	39.5	41.0	42.5	44.0	45.4	46.4	47.6	48.6	
	1000 FT	SL/35	30/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
Cruise Altitude		SL	5	10	15	20	25	30	35	Cruise Speed
True Mach No		0.53	0.57	0.61	0.67	0.73	0.81	0.84	0.87	
DESCENT DIST NAUT MI -		8	16	24	33	41	50	60	MAX RANGE DESCENT	

Figure B4-5 (Sheet 3 of 4)

DIVERSION RANGE SUMMARY TABLE

F CONFIGURATION
DRAG INDEX **62**

Standard Day — No Wind

model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

Climb Speed Schedule and Thrust Settings: 400 KCAS to Recommended Mach Number with Military Thrust.

* Schedules Provide For Arrival at Sea Level with 1000 LB Fuel — Approach and Landing Reserve.

With Over 3500 LB of Fuel Remaining, Fly at 35000 FT at M 0.87 for Optimum Range.

(A) Time & Fuel Included for a Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(B) Time & Fuel Included for a Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

(C) Time & Fuel Included for Climb to Optimum Altitude and Penetration Descent at Destination. Range Does Not Include Distance for Descent at Destination.

(D) Time & Fuel Included for Climb to Optimum Altitude and Maximum Range Descent at Destination. Range Includes Distance for On-Course Descent to Sea Level Destination.

*TOTAL FUEL ON BOARD LB	RANGE AND TIME REMAINING WITH 1000 LB RESERVE AT SL									PROCEDURE
	1000 FT	INITIAL ALTITUDE								
		SL	5	10	15	20	25	30	35	
1500	NAUT MI	29	26	22	19	15	10	7	3	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	5.0	5.2	5.5	5.7	5.9	6.3	6.6	6.8	
	NAUT MI	29	35	44	54	62	78	84	94	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	5.0	6.0	7.7	9.1	10.4	11.4	12.6	13.9	
	1000 FT	SL/10	5/15	10/15	15/20	20/25	25/30	30/35	35/35	OPTIMUM ALTITUDE
	NAUT MI	29	26	22	19	15	10	7	3	Use Optimum Altitude Until Over Base (C)
2000	MINUTES	5.0	5.2	5.5	5.7	5.9	6.3	6.6	6.8	
	NAUT MI	34	42	47	56	68	78	87	94	Use Optimum Altitude and Descend on Course (D)
	MINUTES	5.8	7.3	7.9	8.8	10.9	11.4	13.5	13.9	
	NAUT MI	58	55	56	57	58	59	60	61	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	10.2	10.3	10.6	11.6	11.8	12.1	13.5	13.6	
	NAUT MI	58	68	80	95	108	126	137	148	Cruise at Initial Altitude and Descend on Course (B)
3000	MINUTES	10.2	11.0	13.6	15.0	16.5	17.4	19.2	20.8	
	1000 FT	SL/20	5/25	10/30	15/35	20/35	25/35	30/35	35/35	OPTIMUM ALTITUDE
	NAUT MI	58	55	56	57	58	59	61	61	Use Optimum Altitude Until Over Base (C)
	MINUTES	10.2	10.3	10.6	11.6	11.8	12.1	13.5	13.5	
	NAUT MI	74	84	98	112	120	132	145	148	Use Optimum Altitude and Descend on Course (D)
	MINUTES	11.2	12.4	14.0	16.0	17.1	18.4	19.8	20.8	
4000	NAUT MI	110	118	128	135	146	154	162	166	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	19.5	20.6	21.6	23.0	28.6	24.2	25.7	25.9	
	NAUT MI	110	131	150	172	192	221	238	256	Cruise at Initial Altitude and Descend on Course (B)
	MINUTES	19.5	21.6	24.4	26.0	28.0	29.4	31.5	33.2	
	1000 FT	15/35	15/35	20/35	25/35	30/35	30/35	30/35	35/35	OPTIMUM ALTITUDE
	NAUT MI	116	124	130	142	148	159	162	166	Use Optimum Altitude Until Over Base (C)
4000	MINUTES	19.0	20.2	20.9	22.3	24.3	25.2	25.7	25.9	
	NAUT MI	182	194	208	221	230	241	250	256	Use Optimum Altitude and Descend on Course (D)
	MINUTES	24.2	26.0	27.1	28.4	29.8	31.2	32.6	33.2	
	NAUT MI	168	184	199	214	231	248	264	268	Cruise at Initial Altitude Until Over Base (A)
	MINUTES	28.8	31.1	32.9	34.2	35.2	35.8	38.3	37.8	
	NAUT MI	168	196	222	252	276	316	343	360	Cruise at Initial Altitude and Descend on Course (B)
4000	MINUTES	28.8	32.4	35.4	37.2	38.9	41.0	44.0	45.6	
	1000 FT	30/35	30/35	35/35	35/35	35/35	35/35	35/35	35/35	OPTIMUM ALTITUDE
	NAUT MI	202	216	230	238	248	258	264	268	Use Optimum Altitude Until Over Base (C)
	MINUTES	30.2	32.0	33.3	34.2	35.4	36.8	37.1	37.8	
	NAUT MI	289	300	314	321	339	350	352	360	Use Optimum Altitude and Descend on Course (D)
	MINUTES	37.1	38.4	32.8	41.2	42.8	43.5	44.7	45.6	
Cruise Altitude True Mach No		SL	5	10	15	20	25	30	35	Cruise Speed
		0.53	0.57	0.61	0.67	0.73	0.80	0.83	0.87	
DESCENT DIST NAUT MI -		8	15	23	31	39	47	58	MAX RANGE DESCENT	

Figure B4-5 (Sheet 4 of 4)

DIVERSION ENDURANCE SUMMARY TABLE

CONFIGURATION
DRAG INDEX ► 0

F

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

* SCHEDULES PROVIDE FOR ARRIVAL AT SEA LEVEL WITH 1000 LB
 FUEL APPROACH AND LANDING RESERVE.

[A] TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA
 LEVEL DESTINATION.

[B] TIME & FUEL INCLUDED FOR A MILITARY THRUST CLIMB AT 0.88
 TRUE MACH NUMBER TO OPTIMUM LOITER ALTITUDE.

TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA
 LEVEL DESTINATION.

*TOTAL FUEL ON BOARD LB	1000 FT	INITIAL ALTITUDE								PROCEDURE
		SL	5	10	15	20	25	30	35	
1500	MINUTES	7.0	8.6	10.0	11.3	12.6	13.8	14.8	16.0	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	S. L.	5	10	15	20	25	30	35	
	MINUTES	7.0	8.6	10.0	11.3	12.6	13.8	14.8	16.0	
2000	MINUTES	14.0	15.9	17.6	19.2	20.7	22.0	23.3	24.5	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	25	25	25	25	25	30	35	35	
	MINUTES	14.7	16.6	18.2	19.6	20.9	22.0	23.3	24.5	
3000	MINUTES	27.5	30.1	32.5	34.6	36.7	38.3	39.8	41.0	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	35	35	35	35	35	35	35	35	
	MINUTES	31.0	33.0	34.7	36.2	37.4	38.7	40.0	41.0	
4000	MINUTES	40.7	43.8	46.8	49.6	51.8	53.8	55.7	57.1	LOITER AT INITIAL ALTITUDE [A] OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE [B]
	1000 FT	35	35	35	35	35	35	35	35	
	MINUTES	47.1	49.2	50.9	52.4	53.6	54.9	56.0	57.1	

LOITER SPEEDS AND DESCENT DATA

LOITER ALT (1000 FT)	S. L.	5	10	15	20	25	30	35	
TRUE MACH NUMBER	0.42	0.46	0.50	0.55	0.62	0.69	0.77	0.84	
DESCENT DIST	-	9	18	26	36	45	55	66	NAUT MI
DESCENT TIME	-	1.9	3.7	5.1	6.8	8.1	9.5	11.0	MINUTES

Figure B4-6 (Sheet 1 of 4)

model:	F-105F
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 JULY 1964
data basis:	FLIGHT TEST

DIVERSION ENDURANCE SUMMARY TABLE

F

CONFIGURATION DRAG INDEX ► 28

A TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA LEVEL DESTINATION.

E TIME & FUEL INCLUDED FOR A MILITARY THRUST CLIMB AT 0.88 TRUE MACH NUMBER TO OPTIMUM LOITER ALTITUDE.

TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA LEVEL DESTINATION.

* SCHEDULES PROVIDE FOR ARRIVAL AT SEA LEVEL WITH 1000 LB FUEL APPROACH AND LANDING RESERVE.

*TOTAL FUEL ON BOARD LB	1000 FT	INITIAL ALTITUDE								PROCEDURE
		SL	5	10	15	20	25	30	35	
1500	MINUTES	6.6	8.0	9.5	10.7	11.9	13.0	14.0	15.1	LOITER AT INITIAL ALTITUDE ☐ OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE ☐
	1000 FT	S. L.	5	10	15	20	25	30	35	
	MINUTES	6.6	8.0	9.5	10.7	11.9	13.0	14.0	15.1	
2000	MINUTES	13.1	15.0	16.6	18.1	19.4	20.6	21.8	22.8	LOITER AT INITIAL ALTITUDE ☐ OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE ☐
	1000 FT	10	10	10	15	20	25	30	35	
	MINUTES	13.4	15.2	16.6	18.1	19.4	20.6	21.8	22.8	
3000	MINUTES	25.9	28.2	30.5	32.3	34.1	35.6	36.8	37.8	LOITER AT INITIAL ALTITUDE ☐ OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE ☐
	1000 FT	15	20	25	25	25	25	30	35	
	MINUTES	27.8	29.4	31.0	32.6	34.2	35.6	36.8	37.8	
4000	MINUTES	38.3	41.2	44.0	46.3	48.3	50.1	51.3	52.3	LOITER AT INITIAL ALTITUDE ☐ OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE ☐
	1000 FT	25	25	25	25	25	25	30	35	
	MINUTES	42.3	44.3	45.8	47.5	49.0	50.1	51.3	52.3	

LOITER SPEEDS AND DESCENT DATA

LOITER ALT (1000 FT)	S. L.	5	10	15	20	25	30	35	
TRUE MACH NUMBER	0.42	0.46	0.50	0.55	0.62	0.69	0.77	0.84	
DESCENT DIST	-	8	16	25	34	42	52	63	NAUT MI
DESCENT TIME	-	1.8	3.4	5.0	6.4	7.6	9.0	10.6	MINUTES

Figure B4-6 (Sheet 2 of 4)

DIVERSION ENDURANCE SUMMARY TABLE

CONFIGURATION
DRAG INDEX **42****F**

model:	F-105F
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 JULY 1964
data basis:	FLIGHT TEST

*SCHEDULES PROVIDE FOR ARRIVAL AT SEA LEVEL WITH 1000 LB
FUEL APPROACH AND LANDING RESERVE.

A TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA
LEVEL DESTINATION.

B TIME & FUEL INCLUDED FOR A MILITARY THRUST CLIMB AT 0.88
TRUE MACH NUMBER TO OPTIMUM LOITER ALTITUDE.

TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA
LEVEL DESTINATION.

*TOTAL FUEL ON BOARD LB	1000 FT	INITIAL ALTITUDE								PROCEDURE
		SL	5	10	15	20	25	30	35	
1500	MINUTES	6.4	7.7	9.2	10.4	11.5	12.7	13.6	14.6	LOITER AT INITIAL ALTITUDE A OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE B
	1000 FT	S. L.	5	10	15	20	25	30	35	
	MINUTES	6.4	7.7	9.2	10.4	11.5	12.7	13.6	14.6	
2000	MINUTES	12.8	14.3	16.1	17.5	18.9	20.1	21.1	22.1	LOITER AT INITIAL ALTITUDE A OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE B
	1000 FT	10	10	10	15	20	25	30	35	
	MINUTES	13.1	14.6	16.1	17.5	18.9	20.1	21.1	22.1	
3000	MINUTES	25.2	27.4	29.6	31.5	33.1	34.6	35.6	36.5	LOITER AT INITIAL ALTITUDE A OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE B
	1000 FT	15	20	25	25	25	25	30	35	
	MINUTES	26.8	28.6	29.9	31.8	33.3	34.6	35.6	36.5	
4000	MINUTES	37.3	40.0	42.7	44.9	47.0	48.6	49.7	50.4	LOITER AT INITIAL ALTITUDE A OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE B
	1000 FT	25	25	25	25	25	25	30	35	
	MINUTES	40.8	42.7	44.1	45.7	47.3	48.6	49.7	50.4	

LOITER SPEEDS AND DESCENT DATA

LOITER ALT (1000 FT) TRUE MACH NUMBER	S. L.	5	10	15	20	25	30	35	
	0.41	0.45	0.50	0.55	0.61	0.68	0.77	0.84	
DESCENT DIST	-	8	16	24	33	41	50	60	NAUT MI
DESCENT TIME	-	1.8	3.3	4.8	6.3	7.5	8.8	10.2	MINUTES

Figure B4-6 (Sheet 3 of 4)

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

DIVERSION ENDURANCE SUMMARY TABLE

F

CONFIGURATION  62
 DRAG INDEX

*SCHEDULES PROVIDE FOR ARRIVAL AT SEA LEVEL WITH 1000 LB FUEL APPROACH AND LANDING RESERVE.

A TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA LEVEL DESTINATION.

B TIME & FUEL INCLUDED FOR A MILITARY THRUST CLIMB AT 0.88 TRUE MACH NUMBER TO OPTIMUM LOITER ALTITUDE.

TIME & FUEL INCLUDED FOR A MAXIMUM RANGE DESCENT TO SEA LEVEL DESTINATION.

*TOTAL FUEL ON BOARD LB	1000 FT	INITIAL ALTITUDE								PROCEDURE
		SL	5	10	15	20	25	30	35	
1500	MINUTES	6.1	7.3	8.8	10.0	11.0	12.4	13.1	13.9	LOITER AT INITIAL ALTITUDE A OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE B
	1000 FT	S. L.	5	10	15	20	25	30	35	
	MINUTES	6.1	7.3	8.8	10.0	11.0	12.4	13.1	13.9	
2000	MINUTES	12.4	13.6	15.4	16.7	18.4	19.6	20.2	21.2	LOITER AT INITIAL ALTITUDE A OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE B
	1000 FT	10	10	10	15	20	25	30	35	
	MINUTES	13.0	13.9	15.4	16.7	18.4	19.6	20.2	21.2	
3000	MINUTES	24.2	26.3	28.3	30.6	31.9	33.4	34.0	34.9	LOITER AT INITIAL ALTITUDE A OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE B
	1000 FT	15	20	25	25	25	25	30	35	
	MINUTES	25.8	27.8	28.8	31.1	32.4	33.4	34.0	34.9	
4000	MINUTES	36.0	38.3	41.0	43.0	45.4	46.6	47.7	48.0	LOITER AT INITIAL ALTITUDE A OPTIMUM ALTITUDE LOITER AT OPTIMUM ALTITUDE B
	1000 FT	25	25	25	25	25	25	30	35	
	MINUTES	39.1	40.8	42.2	43.4	45.5	46.6	47.7	48.0	

LOITER SPEEDS AND DESCENT DATA

LOITER ALT (1000 FT)	S. L.	5	10	15	20	25	30	35	
TRUE MACH NUMBER	0.42	0.46	0.50	0.55	0.62	0.68	0.77	0.83	
DESCENT DIST	-	8	15	23	31	39	47	58	NAUT MI
DESCENT TIME	-	1.8	3.1	4.6	6.0	7.2	8.4	9.9	MINUTES

Figure B4-6 (Sheet 4 of 4)

TOTAL FUEL FLOW VS ALTITUDE FOR EXTENDED AFTERBURNER RANGE OPERATION

SPEED 250-260 KCAS
IG FLIGHT

F

F

Model:	F-105F
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 JULY 1964
data basis:	FLIGHT TEST

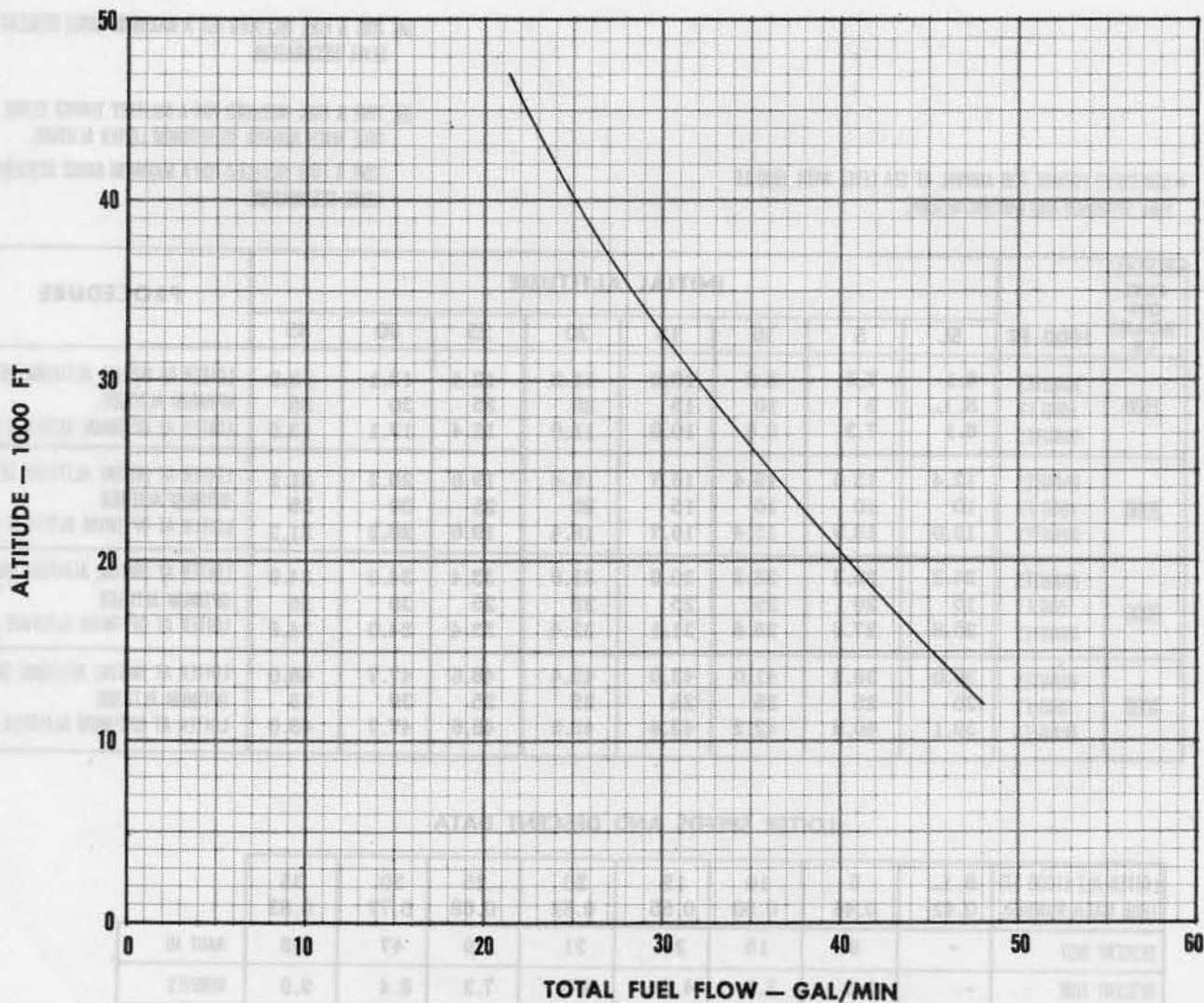


Figure B4-7

PART 5 ENDURANCE

TABLE OF CONTENTS

Maximum Endurance Information B5-1

Maximum Endurance Charts B5-6

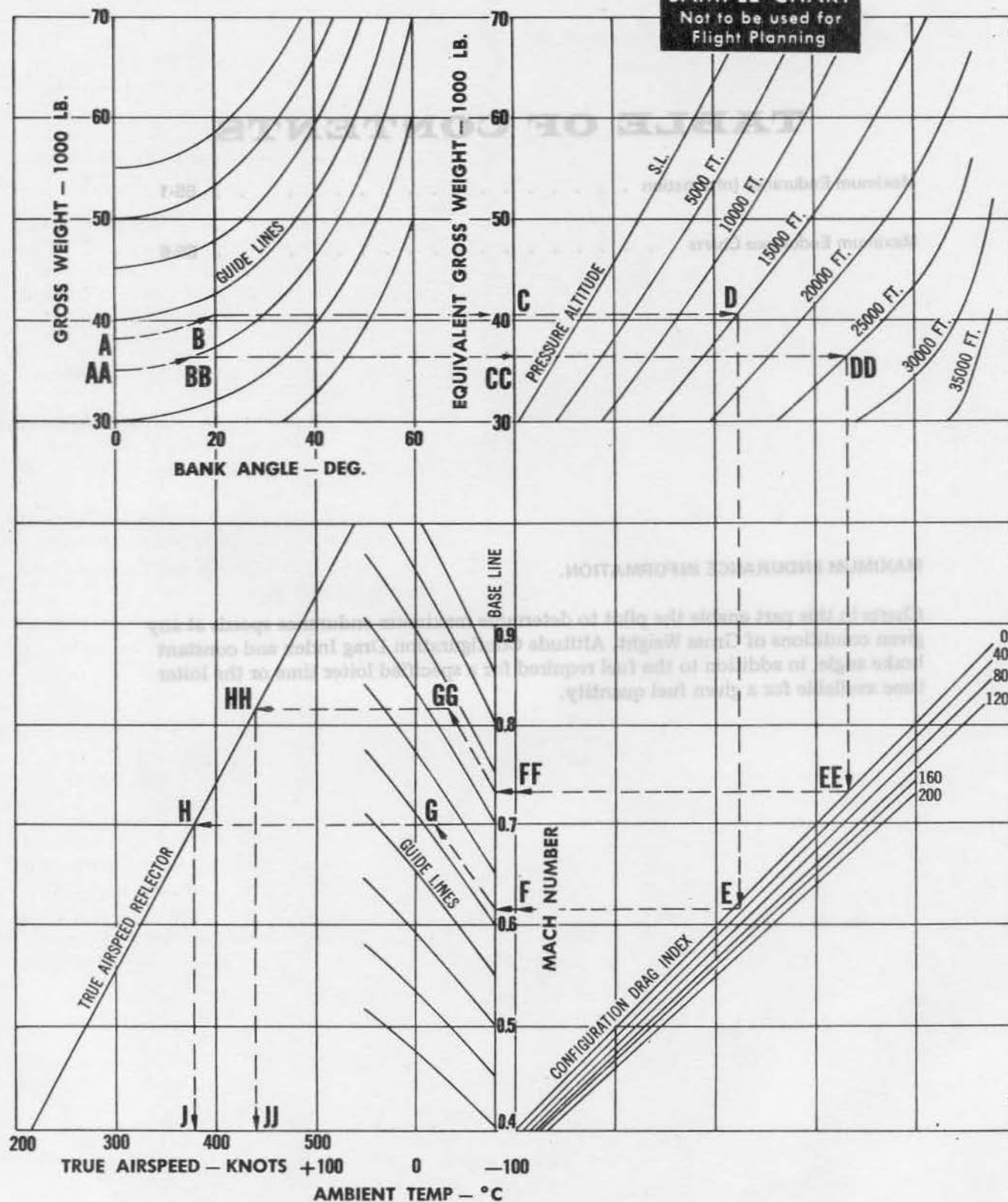
MAXIMUM ENDURANCE INFORMATION.

Charts in this part enable the pilot to determine maximum endurance speeds at any given conditions of Gross Weight, Altitude Configuration Drag Index and constant brake angle, in addition to the fuel required for a specified loiter time or the loiter time available for a given fuel quantity.

MAXIMUM ENDURANCE MACH NUMBER AND TRUE AIRSPEED

F

SAMPLE CHART
Not to be used for
Flight Planning



EXAMPLE I

Conditions: Configuration: Clean + (2) 450 gal tanks

Initial Gross Weight: 41,000 lb

Pressure Altitude: 15,000 ft

Ambient Temperature: 6°C colder than standard day

Bank Angle: 20°

Find: Mach number for Maximum Endurance and fuel used during 60 minutes.

Solution:

1. Determine the configuration drag index from the table on figure B1-5 by adding the various store drag numbers

Store	Location	Store Drag NO.
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb'd	14
Configuration Drag Index =		28

2. Determine standard day ambient temperature at 15,000 ft pressure altitude from Standard Atmosphere Table (figure B1-10) = -14.718°C.
Ambient temperature = Standard -6° = -14.718-6.0 = -20.7°C

3. Estimate Average Gross Weight
Initial Gross Weight = 41,000 lb
Estimated Fuel Used for 60 minutes = 6000 lb
Estimated Final Weight = 41,000-6000 = 35,000 lb
Estimated Average
Gross Weight = $\frac{41,000 + 35,000}{2} = 38,000$ lb

4. Enter sample chart page B5-2 at estimated average gross weight of 38,000 lb, (A) and follow guide lines to 20° bank angle, (B). Read equivalent gross weight = 40,400 lb at (C).

5. Move to the right to 15,000 ft altitude line, (D) and drop down to configuration drag index = 28, (E)

6. Continue to the Mach number scale and read endurance Mach number = 0.617, (F).

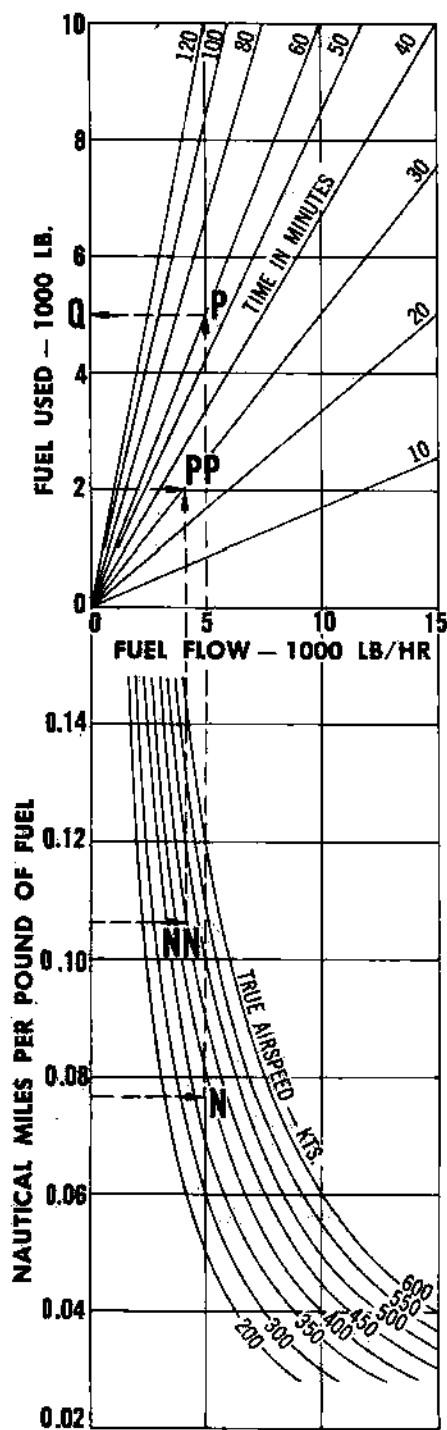
7. Continue to base line and follow guide lines until the ambient temperature of -20.7°C is intersected at (G). Move to the left to true airspeed reflector, (H), and down to the scale to read true airspeed = 380 knots, (J).

8. Enter sample chart page B5-4 at equivalent gross weight = 40,400 lb, (K). Move to the right to 15,000 ft altitude line, (L) and drop down to configuration drag index = 28, (M).

9. Move to the right to true airspeed = 380 knots at (N). Move up to the 60 minute time line, (P) and across to the fuel used scale and read 5000 lb of fuel, (Q).

10. Revised Average Gross Weight Estimate
Initial Gross Weight = 41,000 lb
Fuel Used for 60 Minutes = 5000
Final Gross Weight = 36,000 lb
Average Gross
Weight = $\frac{41,000 + 36,000}{2} = 38,500$ lb

11. Rework steps 4 through 9, entering charts at gross weight = 38,500 lb and find endurance Mach number = 0.625, true airspeed = 382 knots and fuel used for 60 minutes = 5080 lb. (From figure B4-1 read Calibrated Airspeed at 15,000 FT at 0.625 Mach NO. = 318 KCAS.)

F

EXAMPLE II**Conditions:** Configuration: Clean Aircraft

Initial Gross Weight = 36,000 lb

Pressure Altitude = 25,000 ft

Ambient Temperature = Standard Day

Bank Angle = 15°

Find: Maximum endurance time available for 2000 lb of fuel.**Solution:**

1. Determine Standard Day ambient temperature at 25,000 ft pressure altitude from Standard Atmosphere Table (figure B1-10) = -34.53°C

2. Determine Average Gross Weight

Initial Gross Weight = 36,000 lb

Fuel Used for Loiter = 2000 lb

Final Gross Weight = 34,000 lb

Average Gross

$$\text{Weight} = \frac{36,000 + 34,000}{2} = 35,000 \text{ lb}$$

3. Enter sample chart page B5-2 and follow path as in Example I from 35,000 lb. (AA) to bank angle = 15°, (BB), read equivalent gross weight = 36,200 (CC), continue to 25,000 ft altitude line, (DD) to configuration drag index = 0, (EE) to Mach number = 0.732, (FF), to ambient temperature of -34.5°C, (GG), to (HH), and read true airspeed = 440 knots, (JJ).
4. Enter sample chart page B5-4 and follow path as in Example I from 36,200 lb, (KK) to 25,000 ft altitude line, (LL) to configuration drag index = 0, (MM), to true airspeed = 440 knots, (NN).
5. Move up from (NN) to intersect the 2000 lb fuel line at (PP), and read time available = 29 minutes.
6. If required, read calibrated airspeed at 25,000 FT at 0.732 Mach NO. from figure B4-1, = 308 KCAS.

**MAXIMUM ENDURANCE
MACH NUMBER
AND TRUE AIRSPEED**
F

model: F-105F
engine: J75-P-19W
fuel grade: JP-4

fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

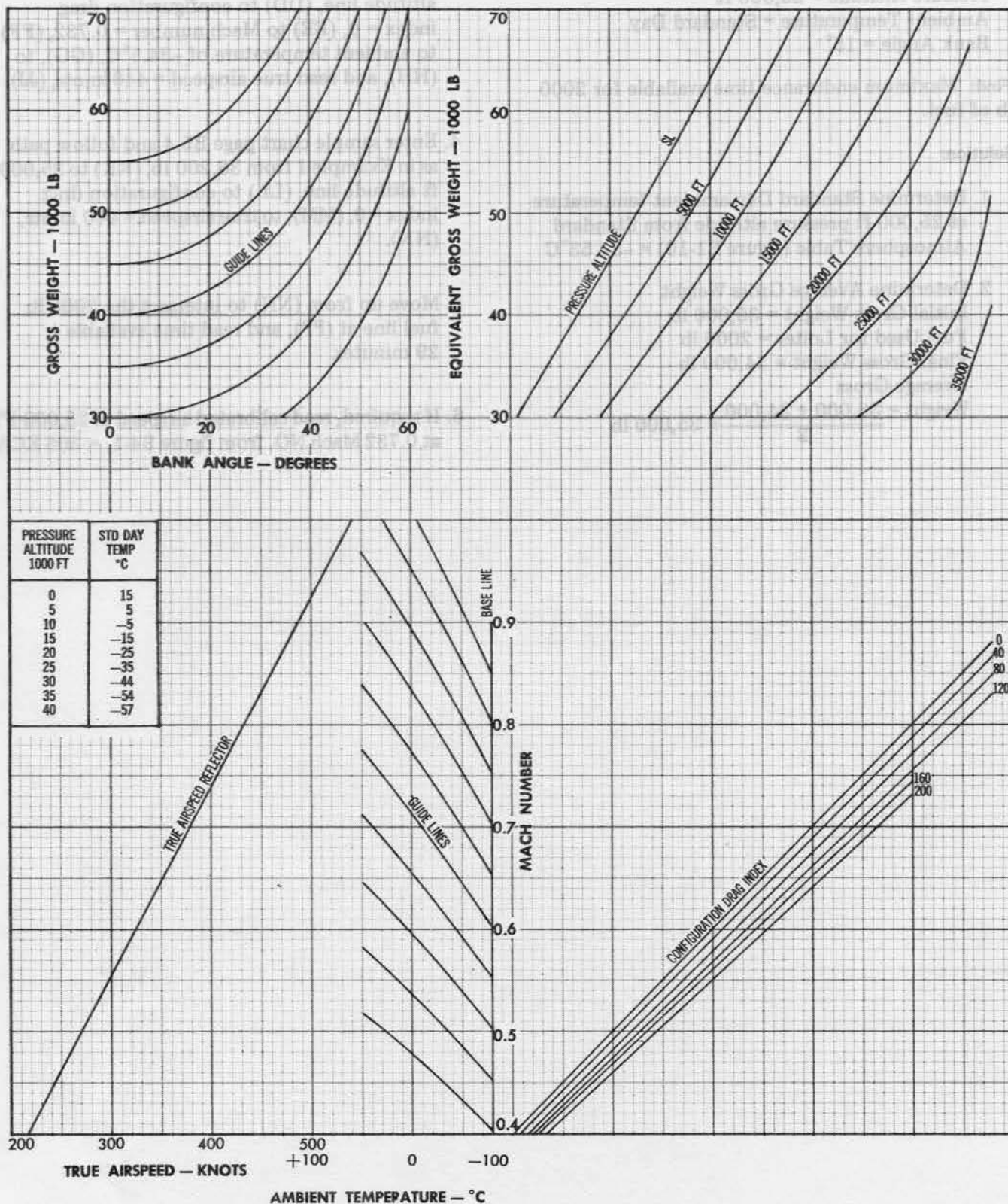


Figure B5-1 (Sheet 1 of 2)

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

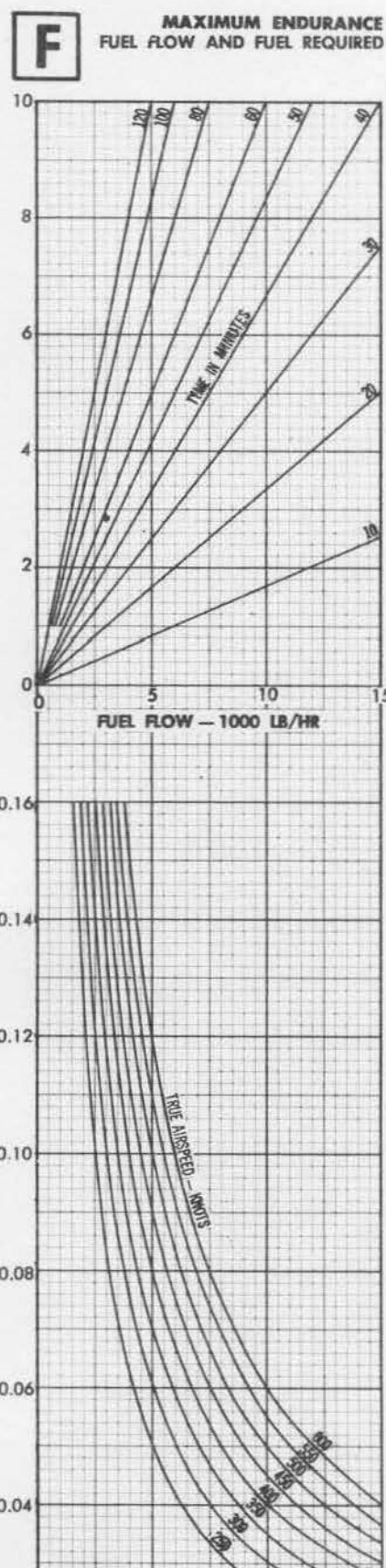
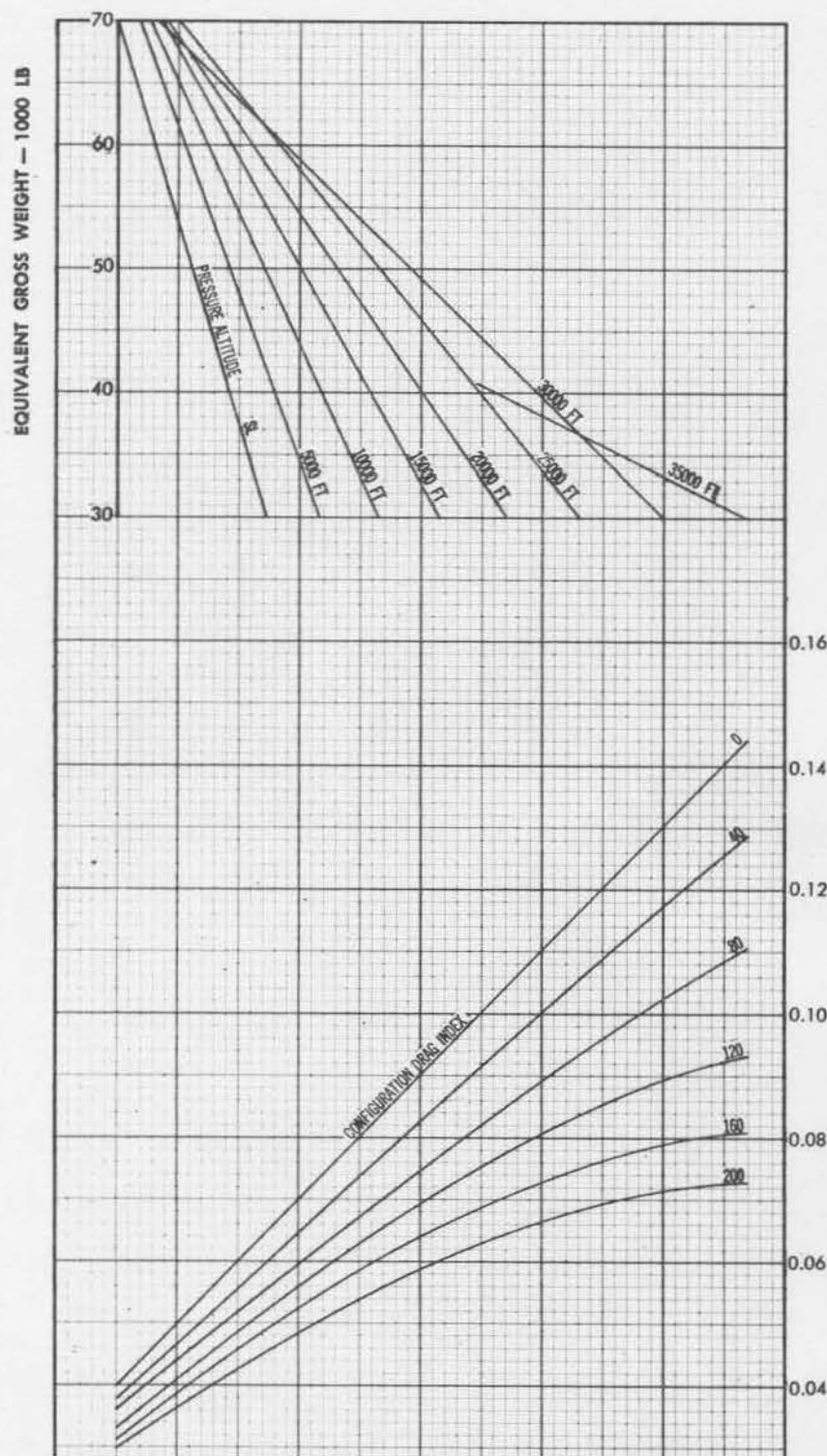


Figure B5-1 (Sheet 2 of 2)

PART 5A LEVEL FLIGHT ACCELERATION

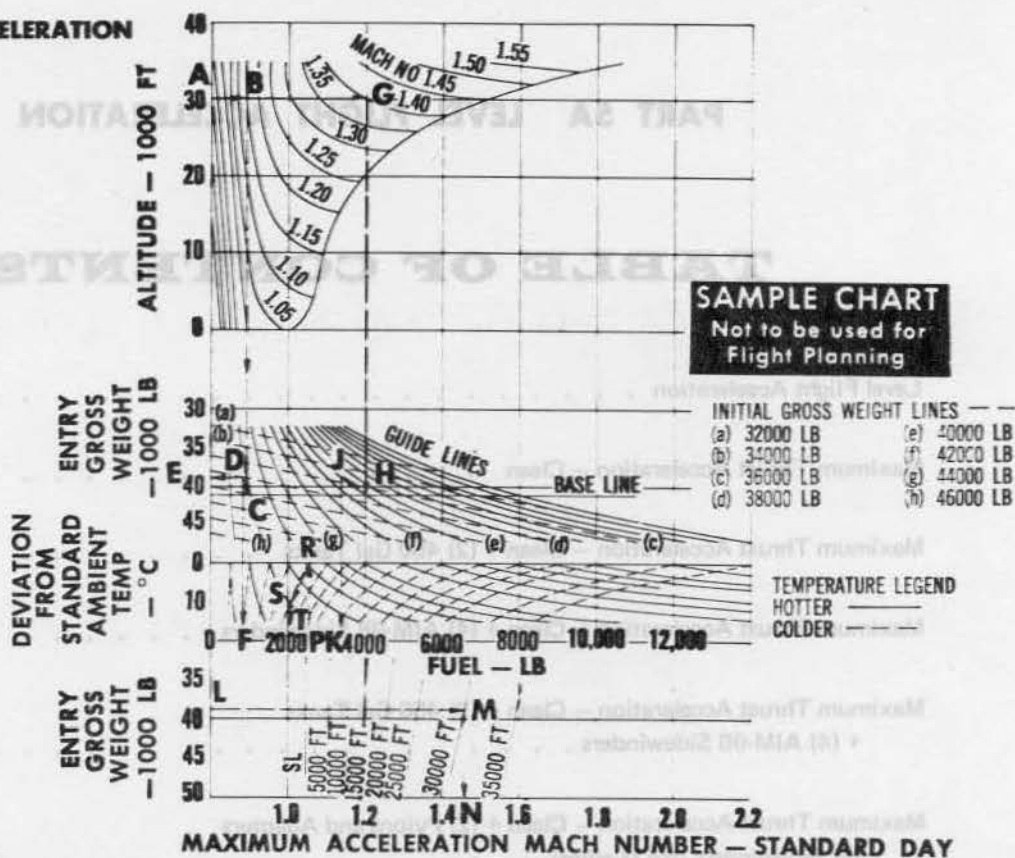
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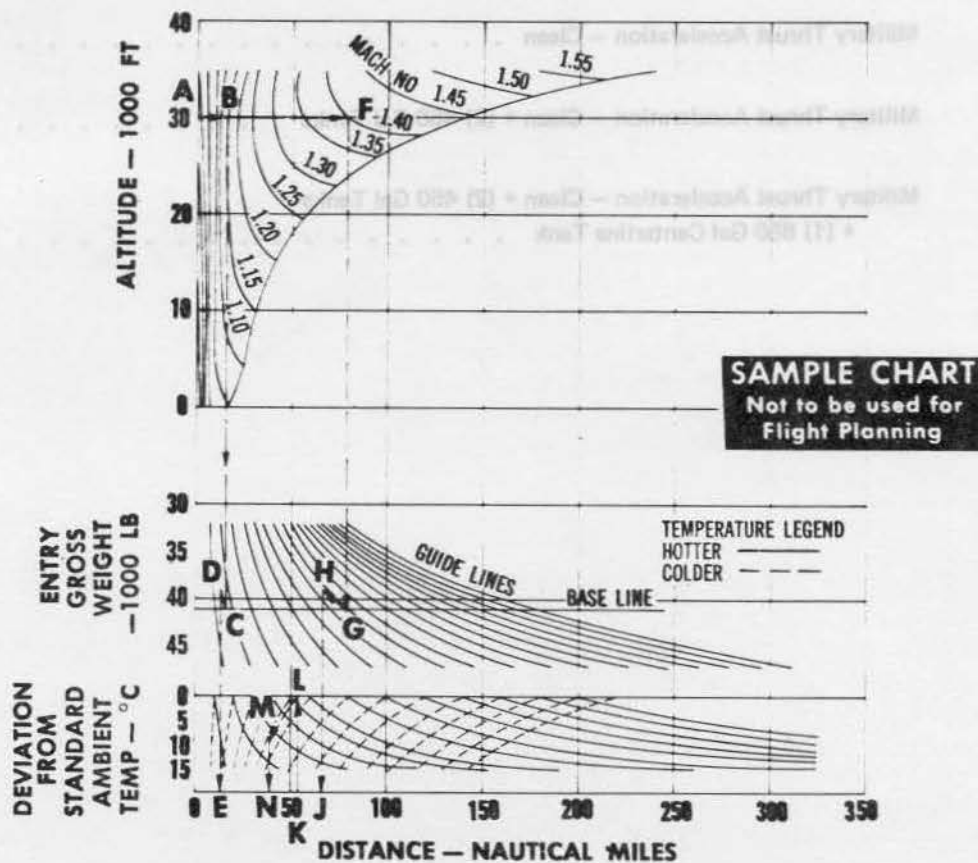
MAXIMUM THRUST ACCELERATION

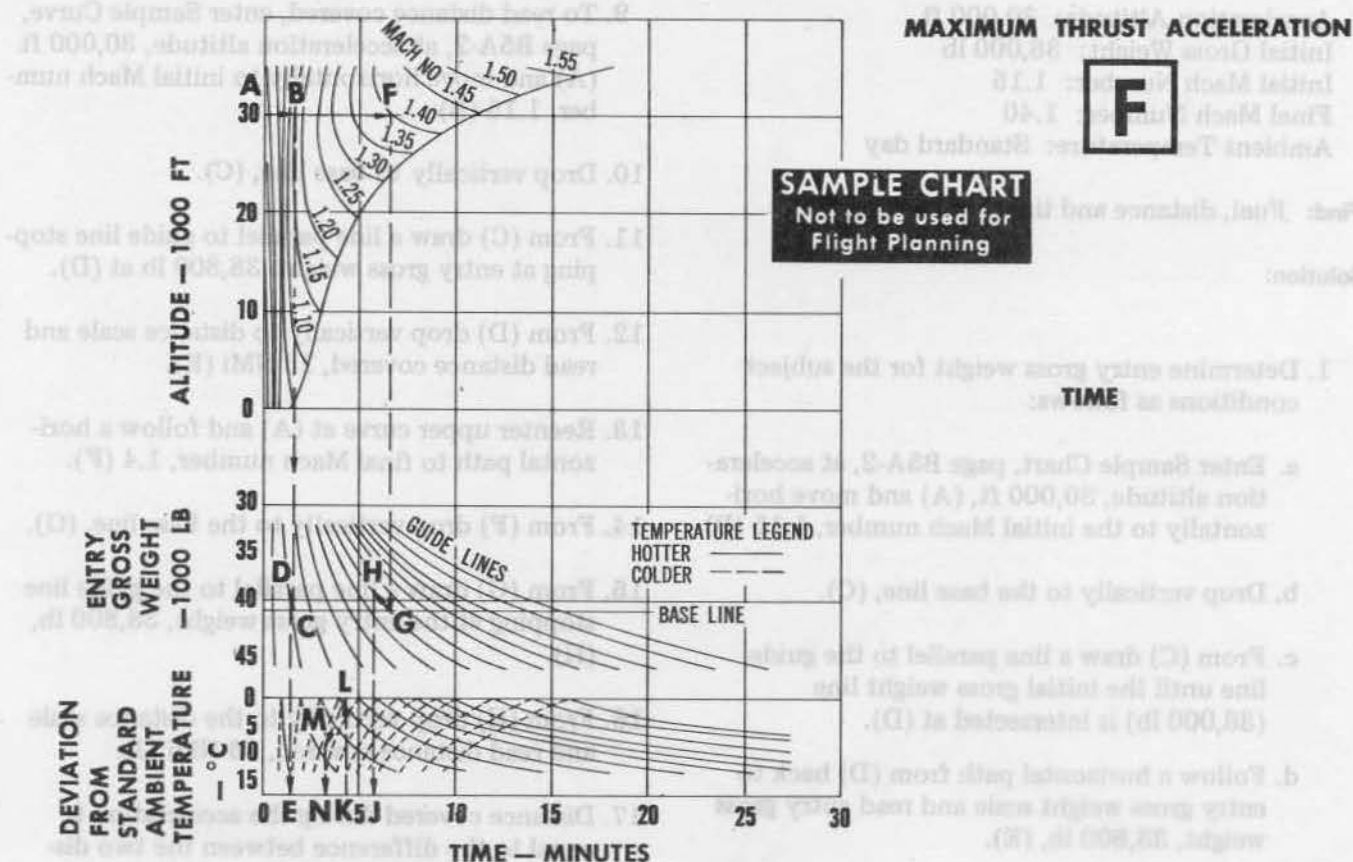
F

FUEL



DISTANCE





LEVEL FLIGHT ACCELERATION.

Maximum Thrust Acceleration Charts are provided for five configurations. (1) Clean, (2) Clean + (4) AIM-9B sidewinder missiles, (3) Clean + (2) 450 gallon tanks + (4) AIM-9B sidewinder missiles, (4) Clean + (2) pylons + adapters for sidewinders, and (5) Clean + (2) 450 gallon tanks. Fuel used, distance covered and time elapsed can be read for a maximum thrust level flight acceleration for any combination of altitude, weight, Mach number and ambient temperature conditions. In addition, maximum acceleration Mach number for standard day conditions is shown.

Use:

To obtain fuel, distance and time to accelerate at a constant altitude, an entry gross weight for a set of initial conditions must be read from the fuel chart. Once entry gross weight has been determined fuel, distance and time can be read from these charts as described in Examples I and II. However, it should be noted that the final speed required may exceed maximum acceleration conditions for the aircraft. Therefore, a maximum acceleration Mach number is read to verify the capability of any desired acceleration. For standard day conditions,

the maximum acceleration Mach number can be read directly from the lower portion of the fuel chart. For non-standard temperature conditions, the final acceleration gross weight must be determined so that the maximum acceleration Mach number can be read from the Maximum Thrust Combat Allowance Chart.

Examples I and II show the procedure for reading these acceleration Charts according to the following general pattern:

1. Determine entry gross weight.
2. Find fuel used during the acceleration.
3. Read maximum acceleration Mach number.
4. Find distance covered during the acceleration.
5. Find time elapsed during the acceleration.

EXAMPLE I

Conditions: Configuration: Clean + (4) AIM-9B sidewinder missiles.

Acceleration Thrust Setting: Maximum

Acceleration Altitude: 30,000 ft
 Initial Gross Weight: 38,000 lb
 Initial Mach Number: 1.15
 Final Mach Number: 1.40
 Ambient Temperature: Standard day

Find: Fuel, distance and time to accelerate.

Solution:

1. Determine entry gross weight for the subject conditions as follows:
 - a. Enter Sample Chart, page B5A-2, at acceleration altitude, 30,000 ft, (A) and move horizontally to the initial Mach number, 1.15 (B).
 - b. Drop vertically to the base line, (C).
 - c. From (C) draw a line parallel to the guide line until the initial gross weight line (38,000 lb) is intersected at (D).
 - d. Follow a horizontal path from (D) back to entry gross weight scale and read entry gross weight, 38,800 lb, (E).
2. From (D) drop vertically to fuel scale and read fuel, 800 lb, (F).
3. Reenter upper curve at (A) and follow a horizontal path to final Mach number, 1.4, (G).
4. From (G) drop vertically to the base line, (H).
5. From (H) draw a line parallel to the guide line stopping at the *entry gross weight*, 38,800 lb (J).
6. From (J) drop vertically to the fuel scale and read fuel, 3360 lb (K).
7. Fuel used to accelerate is equal to the difference between the two fuel readings at (K) and (F) or $(3360 - 800 = 2560 \text{ lb})$.
8. At this point check that the final Mach number does not exceed maximum acceleration Mach number by the method shown below:
 - a. Enter Maximum Acceleration Mach Number Curve at bottom of page B5A-2 at entry gross weight, 38,800 lb, (L) and move horizontally to the 30,000 ft acceleration altitude line, (M).
 - b. Drop vertically to Mach scale and read maximum acceleration Mach number, 1.457 (N).

9. To read distance covered, enter Sample Curve, page B5A-2, at acceleration altitude, 30,000 ft (A) and move horizontally to initial Mach number, 1.15 (B).
10. Drop vertically to base line, (C).
11. From (C) draw a line parallel to guide line stopping at entry gross weight, 38,800 lb at (D).
12. From (D) drop vertically to distance scale and read distance covered, 13 NMi (E).
13. Reenter upper curve at (A) and follow a horizontal path to final Mach number, 1.4 (F).
14. From (F) drop vertically to the base line, (G).
15. From (G) draw a line parallel to the guide line stopping at the entry gross weight, 38,800 lb, (H).
16. From (H) drop vertically to the distance scale and read distance covered, 66 NMi (J).
17. Distance covered during the acceleration is equal to the difference between the two distance readings at (J) and (E) or $(66 - 13 = 53 \text{ NMi})$.
18. Time to accelerate is read from Sample Curve, page B5A-3, using the same procedure as outlined in steps 9 through 17. Time to accelerate is equal to the difference between the two time readings at (J) and (E) or $(5.8 - 1.4 = 4.4 \text{ Min})$.

EXAMPLE II

Conditions: Same as Example I except that Ambient temperature is 10°C colder than standard day.

Find: Fuel, distance and time to accelerate.

Solution:

1. Proceed as shown in Example I for steps 1 through 7 to determine fuel used for standard day, 2560 lb.
2. Enter Temperature Curve at standard day fuel used at 2560 lb, (P) and move up to 0° Deviation from standard day at (R).
3. From (R) proceed parallel to colder guide line stopping at 10°C temperature deviation, (S).

4. From (S) drop vertically to fuel scale and read fuel used = 2050 lb (T).
5. To read distance covered proceed as in Example I from step 9 through 17 and read standard day distance covered, 53 NMi.
6. Enter Sample curve at standard day distance covered at (K) and move up to 0° deviation from standard day at (L).
7. From (L) proceed parallel to guide line stopping at 10° C temperature deviation at (M).
8. From (M) drop vertically to distance scale and read distance covered = 38 NMi (N).
9. To read time elapsed proceed as in Example I, step 18 and read standard day time elapsed, 4.4 Min.
10. Enter Sample Curve and proceed as shown in

steps 6 through 8 and read time elapsed = 3.2 Min (N).

Note

The approximate maximum acceleration Mach number can only be read from these curves for standard day conditions. To determine the maximum Mach for other temperature conditions proceed as follows:

1. Read fuel used (step 4).
2. Subtract fuel used from initial gross weight.
(38,000 lb - 2050 lb = 35,950 lb = final acceleration gross weight.)
3. Enter Maximum Thrust combat allowance chart, page B9-4 at final gross weight of 35,950 lb and read high speed at 30,000 ft at standard day -10° C for the Configuration Drag Index.

LEVEL FLIGHT ACCELERATION – MILITARY THRUST

DESCRIPTION:

Military Thrust acceleration charts are provided for three configurations 1) Clean aircraft, 2) Clean + (2) 450 gallon tanks (inboard), and 3) Clean + centerline 650 gallon tank + (2) 450 gallon tanks (inboard). Fuel used, distance covered and time elapsed can be read for Military Thrust level flight acceleration for any combination of altitude, gross weight and Mach number under standard day conditions, as well as maximum acceleration Mach number.

USE:

Fuel, distance, and time are obtained by the same method. Fuel is determined in the example below. It should be noted that the final speed required should be checked against the maximum acceleration Mach number to verify the aircraft's capability to perform the desired acceleration with Military Thrust.

EXAMPLE:

Conditions:

Configuration:	Clean
Acceleration Thrust Setting:	Military
Acceleration Altitude:	10,000 ft
Initial Gross Weight:	40,000 lb
Initial Mach Number:	0.65
Final Mach Number:	0.95

Find: Fuel, distance, and time to accelerate.

Solution:

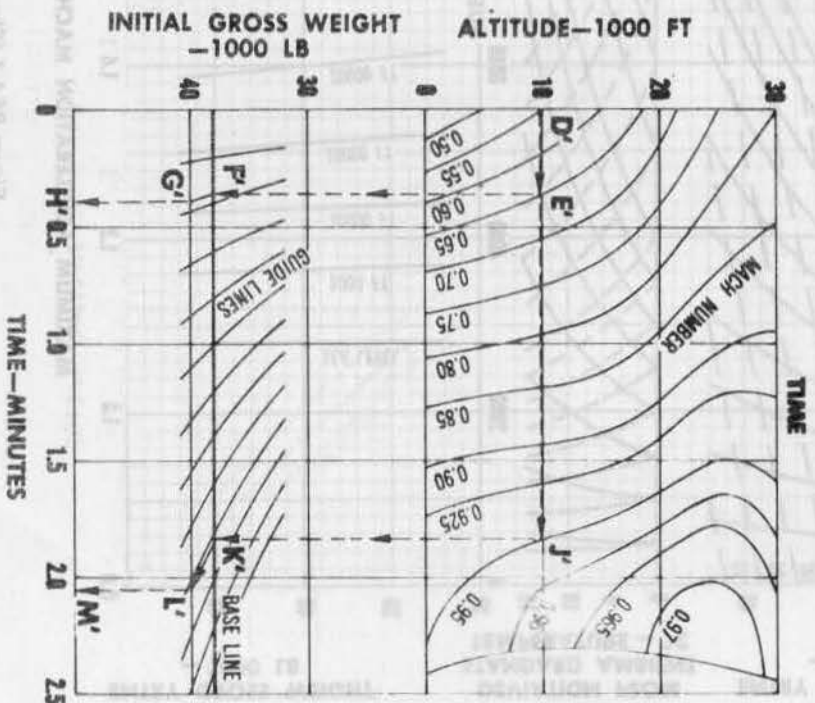
1. Determine that the final Mach number does not exceed the maximum acceleration Mach number. Enter the Maximum Acceleration Mach Number Curve at the top left of page B5A-7A at the initial gross weight, 40,000 lb.

(A) move horizontally to the 10,000 ft acceleration altitude line, (B) and drop vertically to the Mach No. scale to read maximum acceleration Mach number = 0.961, (C). Since the required final Mach numbers (0.95) is within the aircraft's Military Thrust Acceleration capability, continue.

2. Find fuel used:

- (a) Enter Sample Chart, top left on page B5A-7, at acceleration altitude 10,000 ft, (D); move horizontally to the initial Mach number = 0.65, (E) and drop vertically to the base line, (F).
- (b) From (F) draw a line parallel to the guide line until the initial gross weight is intersected at (G), drop vertically to the fuel scale and read fuel = 47 lb, (H).
- (c) Re-enter chart at (D) and follow a horizontal path to final Mach number = 0.95, (J) drop vertically to the baseline, (K). Draw a line parallel to the guide line until the initial gross weight is intersected at (L) and drop vertically to the fuel scale to read fuel = 408 lb, (M).
- (d) Fuel used to accelerate is equal to the difference between the two fuel readings (M) and (H), or $(408 - 47 = 361 \text{ lb})$.

3. Distance covered and time elapsed during the acceleration are obtained by using the same procedure as outlined in steps 2a through 2d. The distance and time sample charts are found on page B5A-7. The time to accelerate is equal to the difference between (M') and (H') or $(206 - 0.40) = 1.66 \text{ min}$. The distance covered in the acceleration is equal to the difference between (M'') and (H''), or $(17.10 - 2.60) = 14.50 \text{ NMi}$.



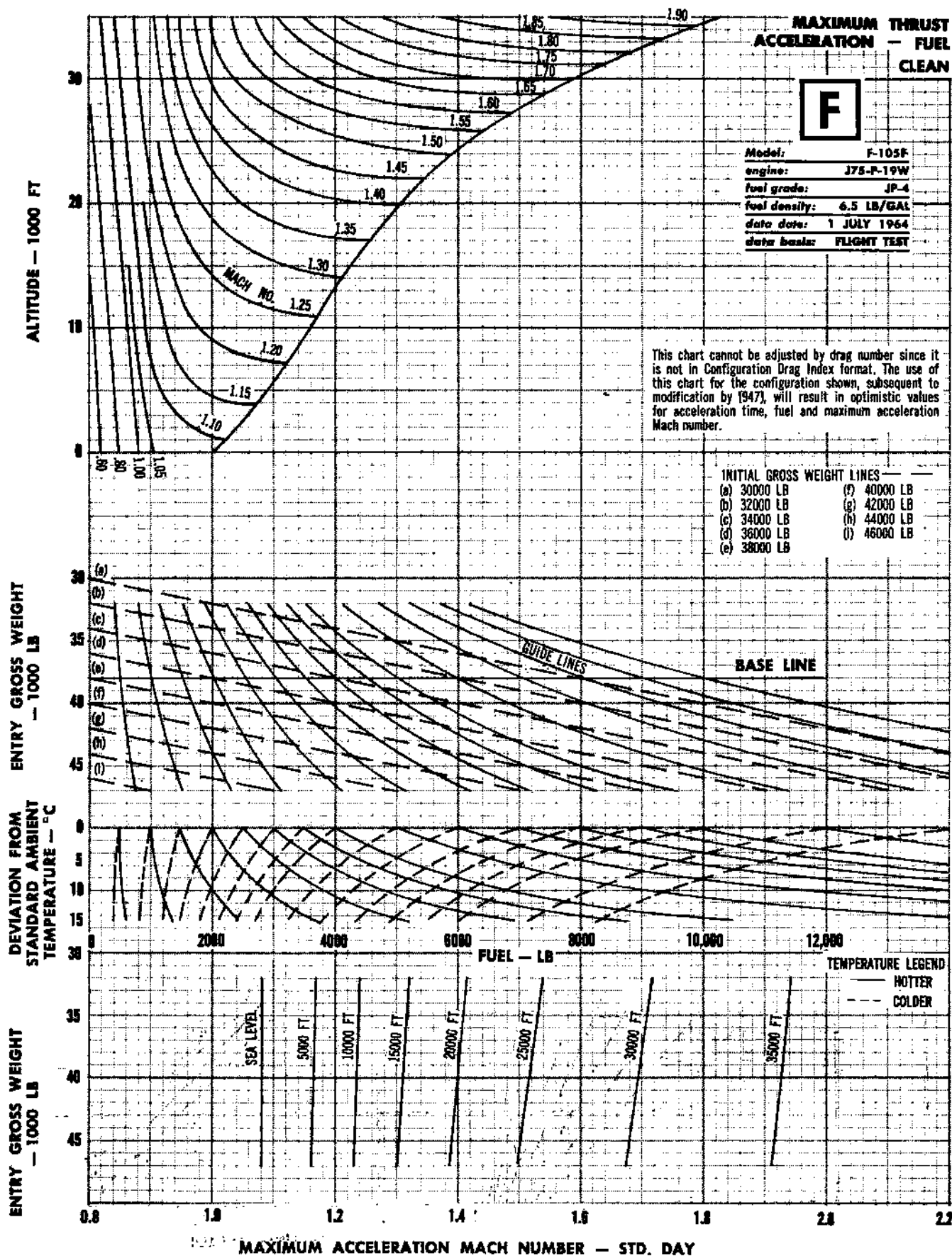


Figure B5A-1 (Sheet 1 of 3)

MAXIMUM THRUST ACCELERATION — DISTANCE CLEAN



model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

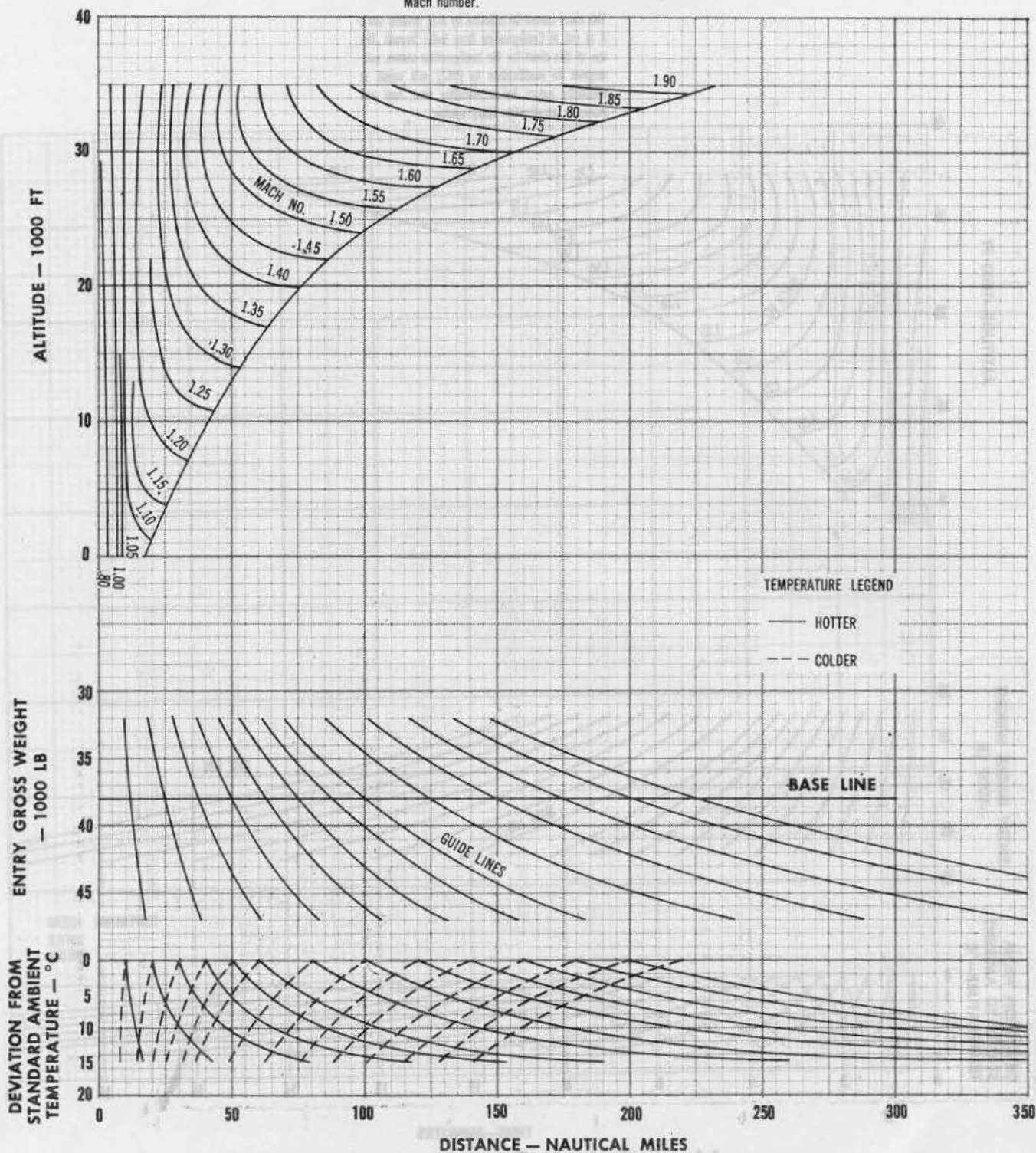


Figure B5A-1 (Sheet 2 of 3)

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST



MAXIMUM THRUST ACCELERATION — TIME CLEAN

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

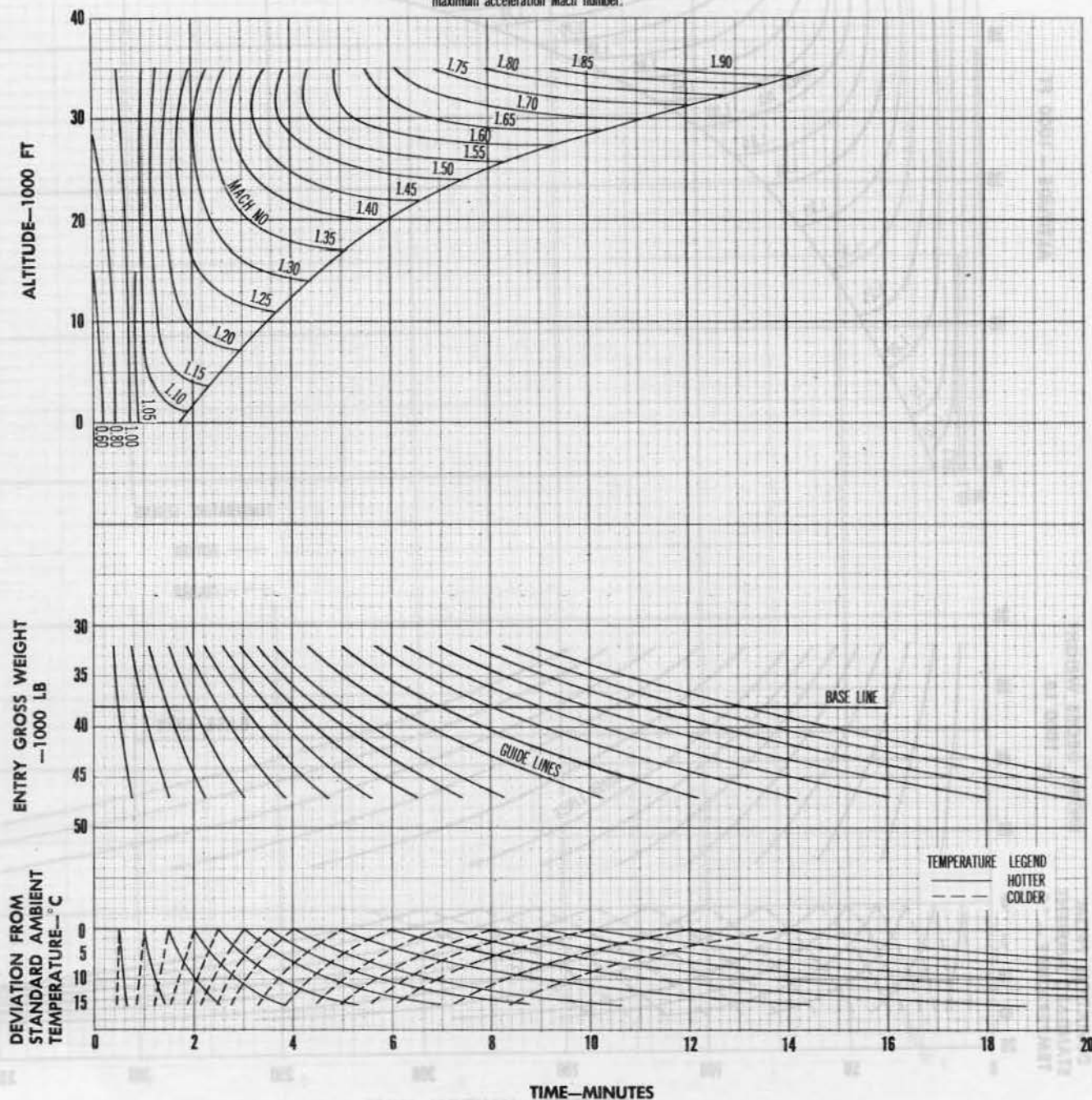


Figure B5A-1 (Sheet 3 of 3)

**MAXIMUM THRUST ACCELERATION — FUEL
CLEAN + (2) 450 GAL TANKS**
F

model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST

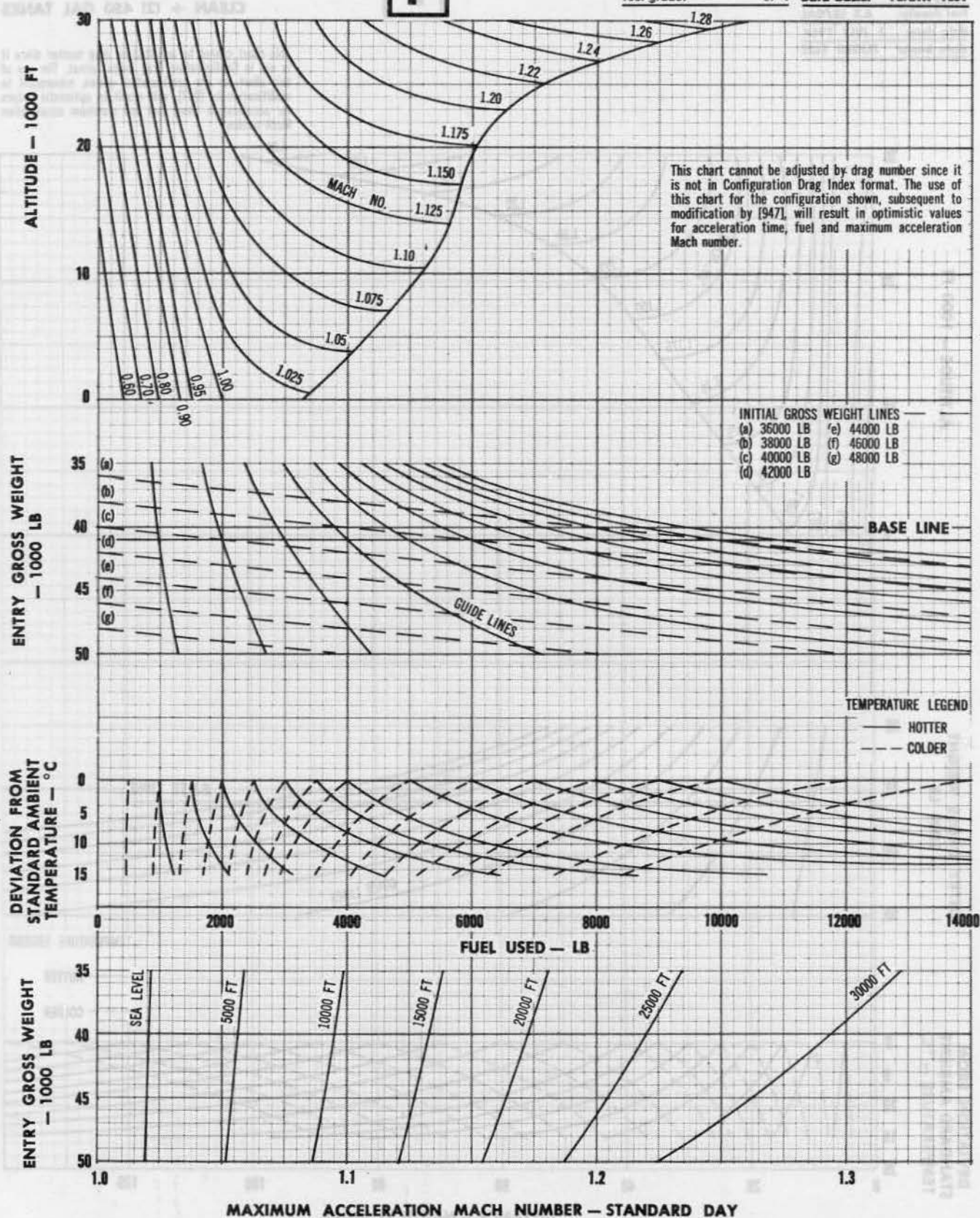


Figure B5A-2 (Sheet 1 of 3)

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

F

MAXIMUM THRUST ACCELERATION
DISTANCE
CLEAN + (2) 450 GAL TANKS

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

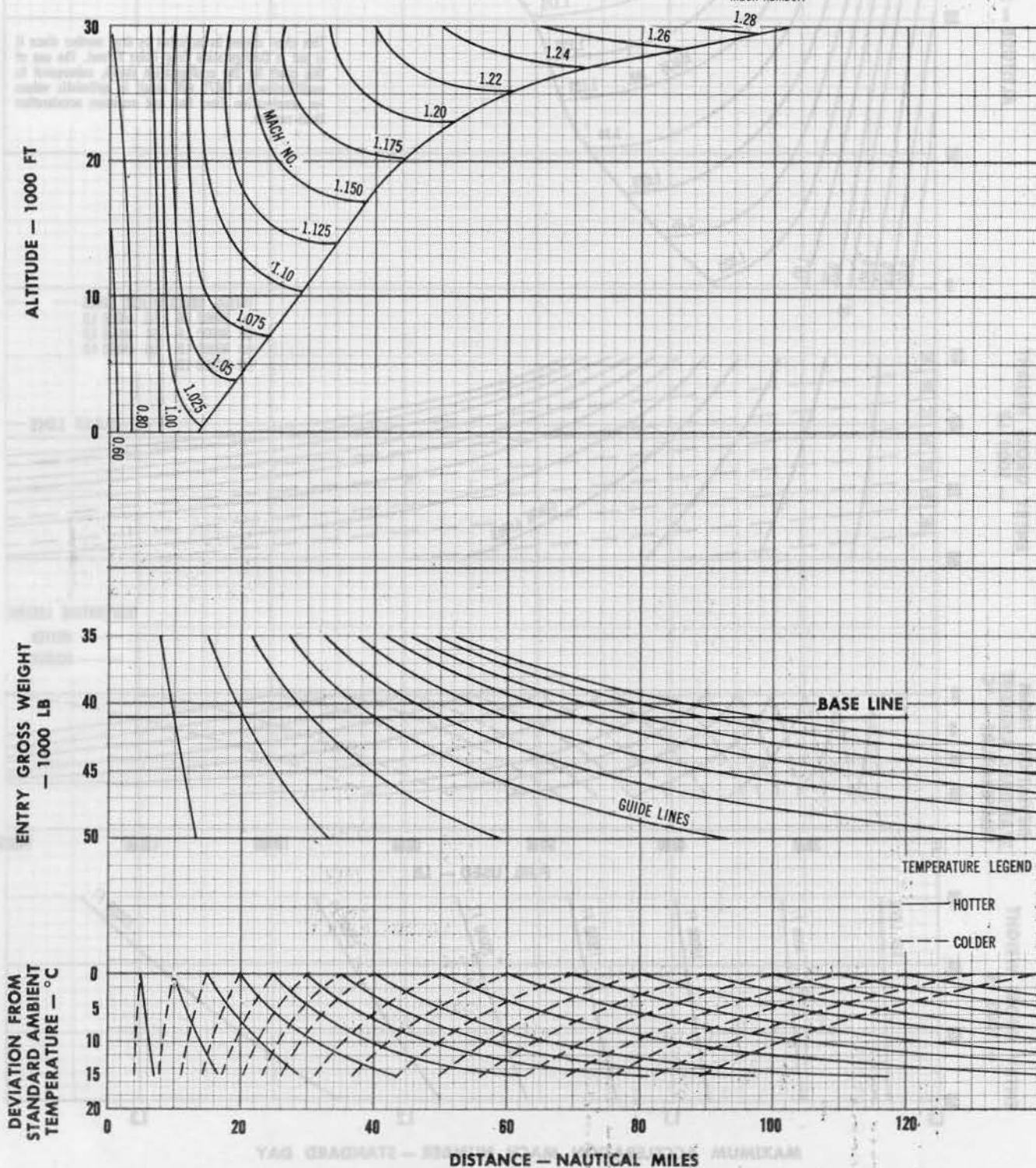


Figure B5A-2 (Sheet 2 of 3)

**MAXIMUM THRUST ACCELERATION
TIME
CLEAN + (2) 450 GAL TANKS**

F

model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

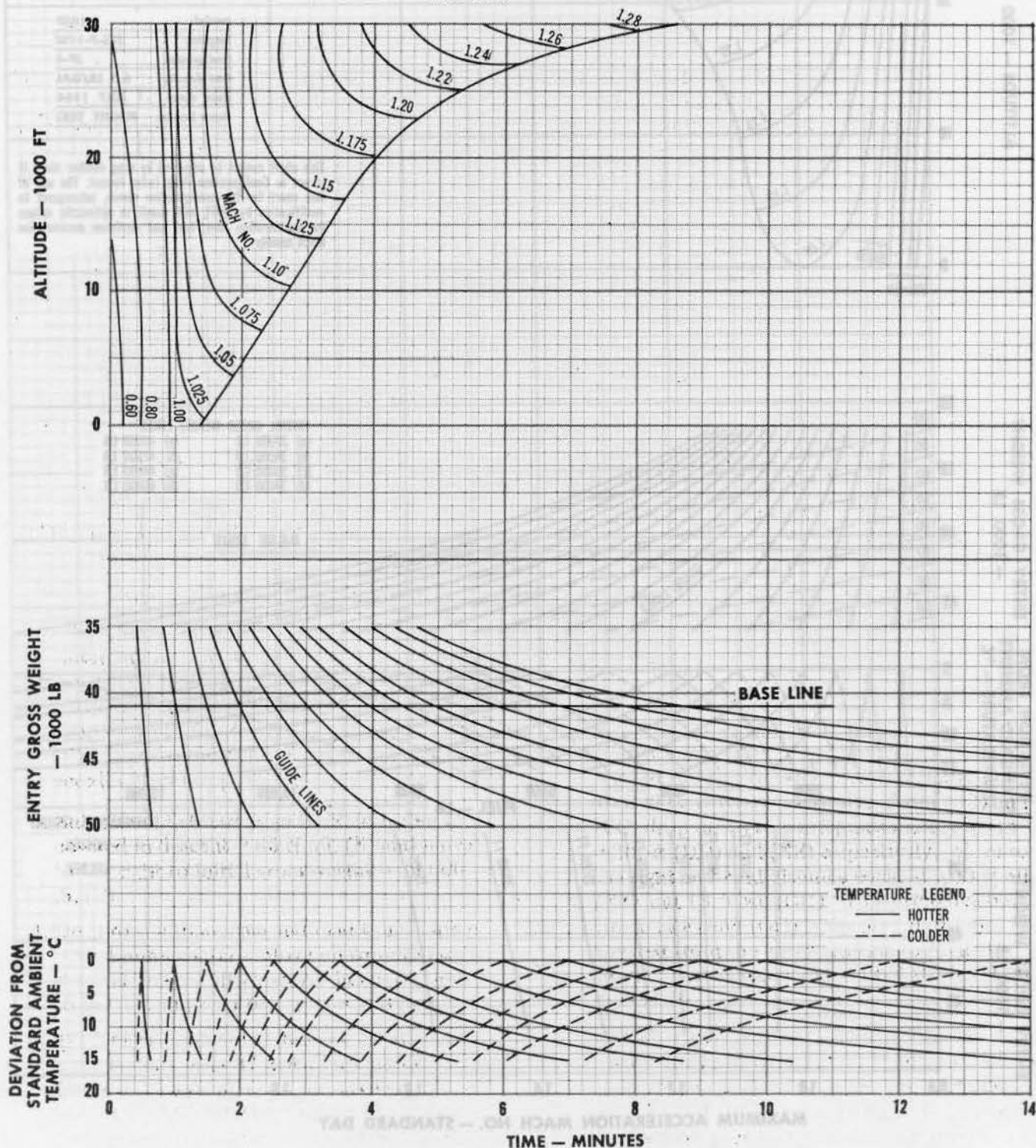
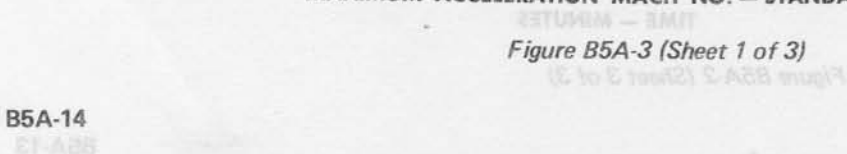


Figure B5A-2 (Sheet 3 of 3)



**MAXIMUM THRUST ACCELERATION
DISTANCE**
CLEAN + (4) AIM - 93 SIDEWINDERS



model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST

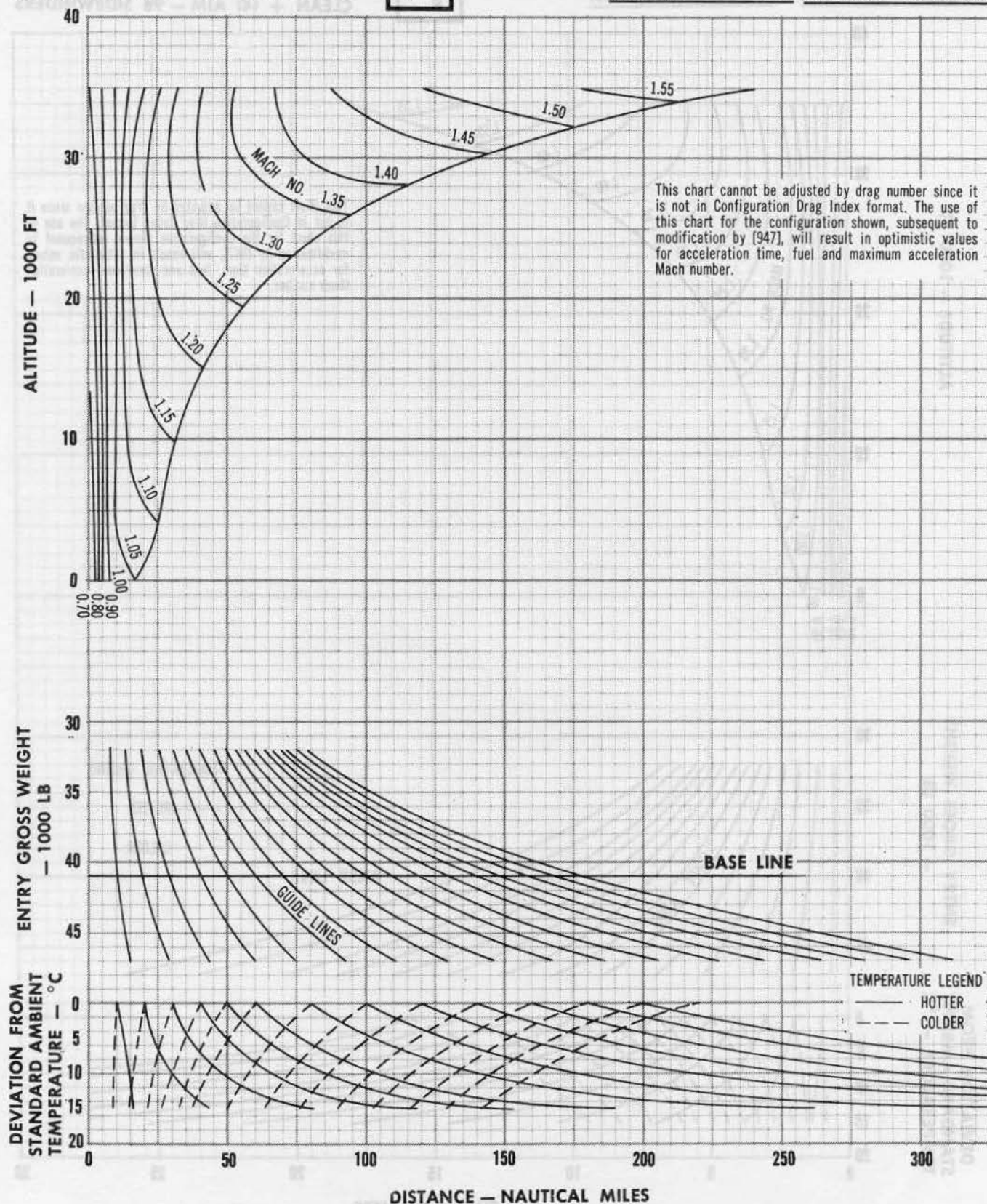


Figure B5A-3 (Sheet 2 of 3)

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4

fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST



MAXIMUM THRUST ACCELERATION TIME CLEAN + (4) AIM - 9B SIDEWINDERS

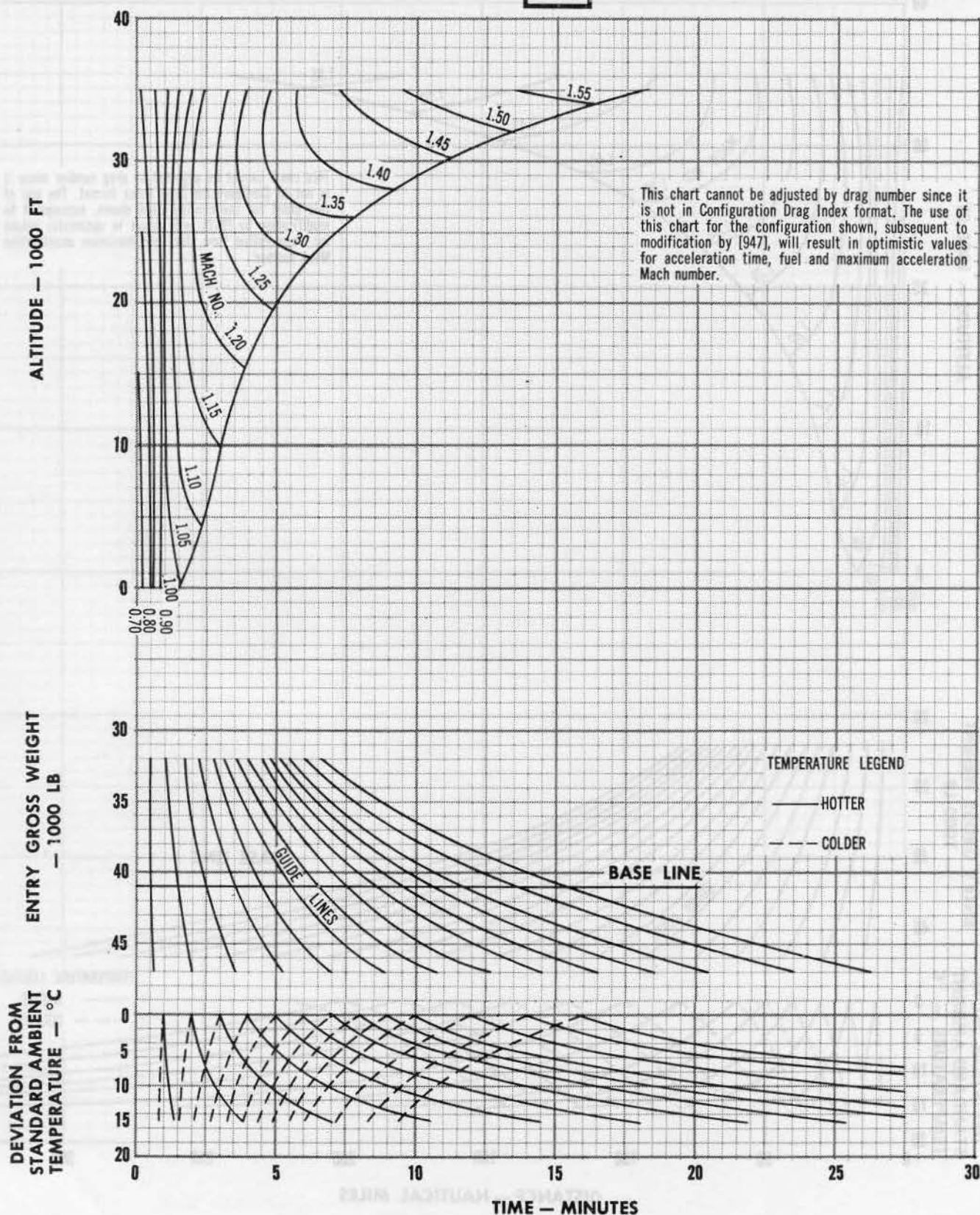
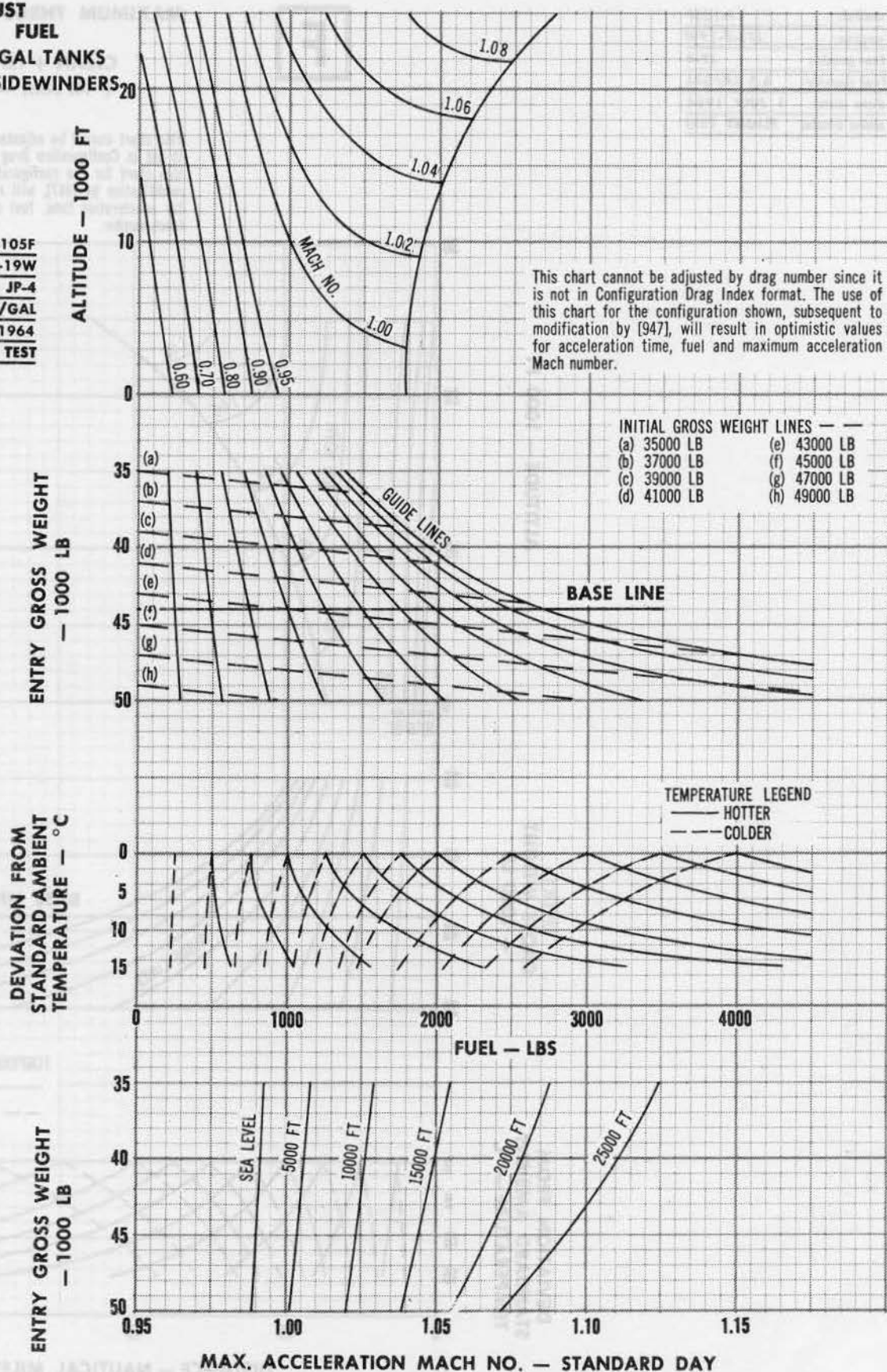


Figure B5A-3 (Sheet 3 of 3)

**MAXIMUM THRUST
ACCELERATION FUEL**
CLEAN + (2) 450 GAL TANKS
+ (4) AIM - 9B SIDEWINDERS



model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST



This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

Figure B5A-4 (Sheet 1 of 3)

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

F

MAXIMUM THRUST ACCELERATION DISTANCE

CLEAN + (2) 450 GAL TANKS
 + (4) AIM - 9B SIDEWINDERS

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

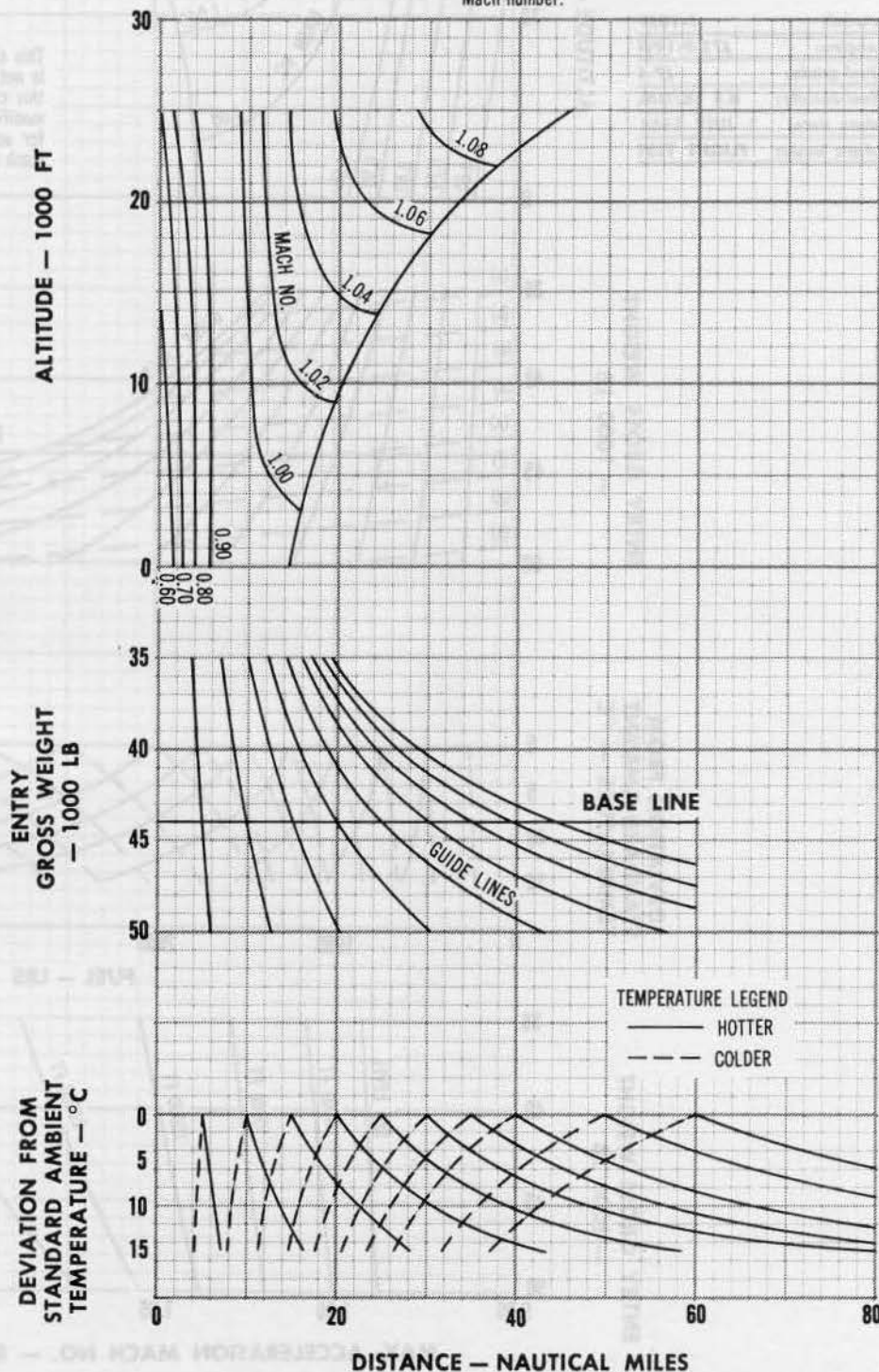


Figure B5A-4 (Sheet 2 of 3)

**MAXIMUM THRUST ACCELERATION
TIME**

CLEAN + (2) 450 GAL TANKS
+ (4) AIM - 9B SIDEWINDERS

F

model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

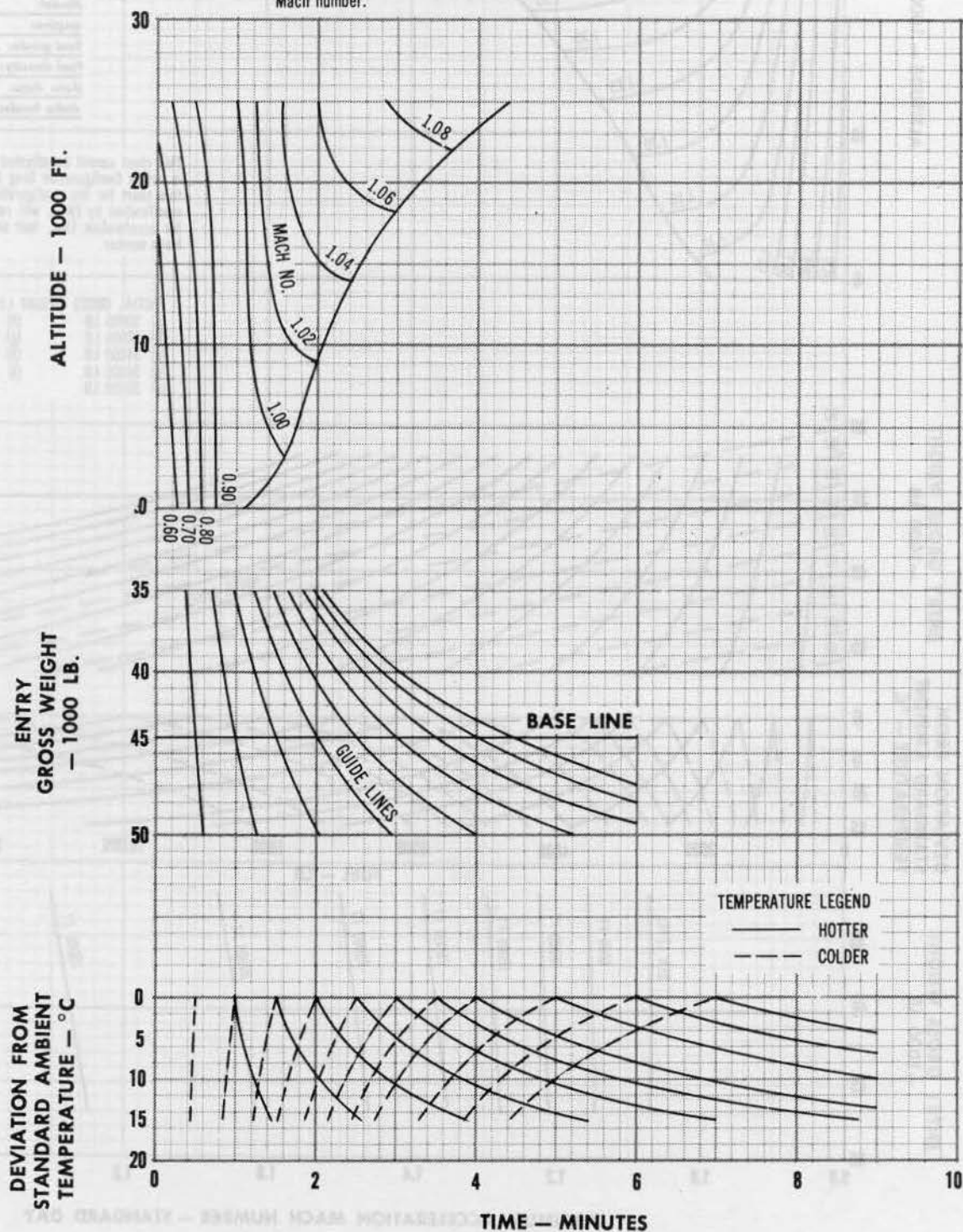


Figure B5A-4 (Sheet 3 of 3)

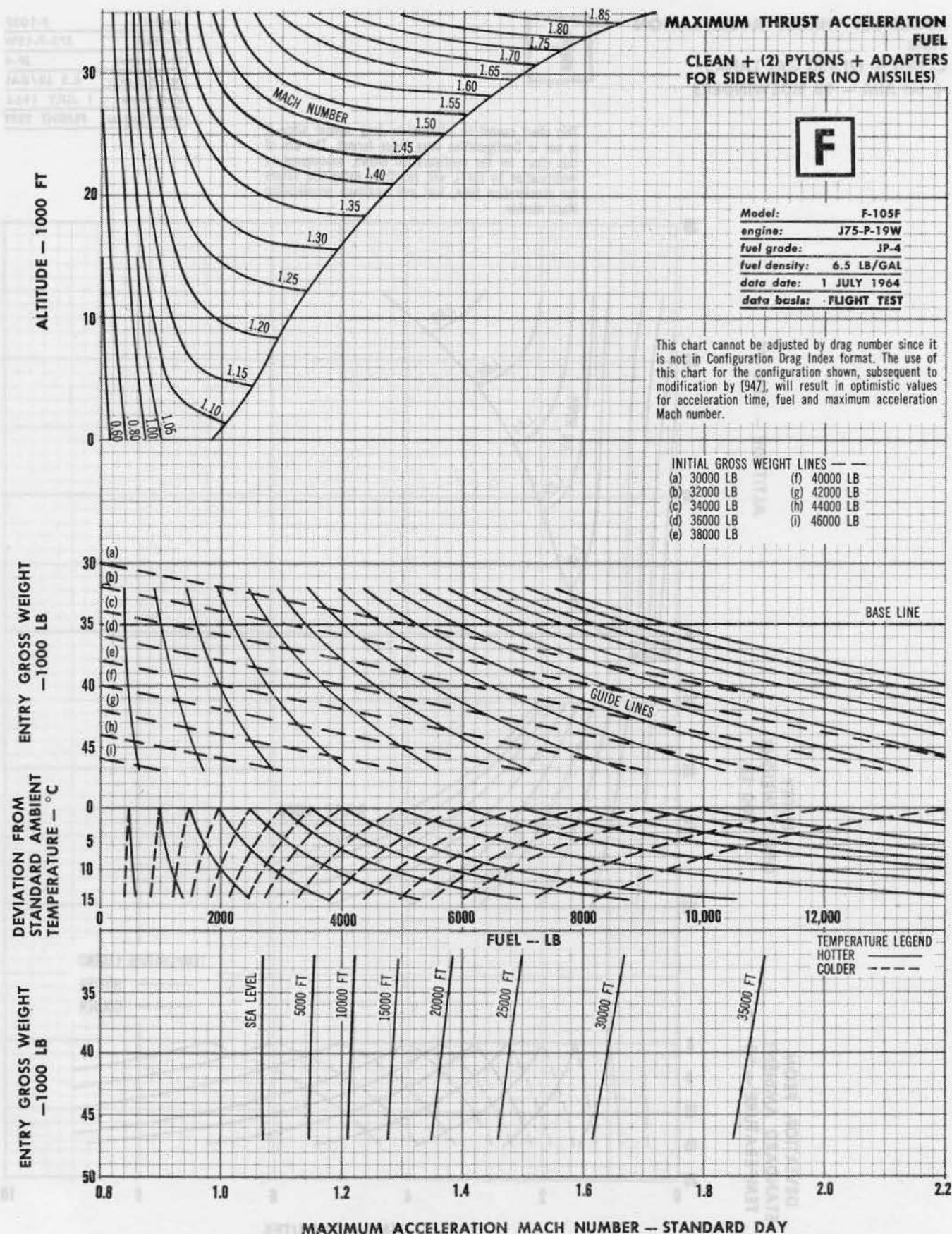


Figure B5A-5 (Sheet 1 of 3)

**MAXIMUM THRUST ACCELERATION
DISTANCE
CLEAN + (2) PYLONS + ADAPTERS
FOR SIDEWINDERS (NO MISSILES)**



Model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by (947), will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

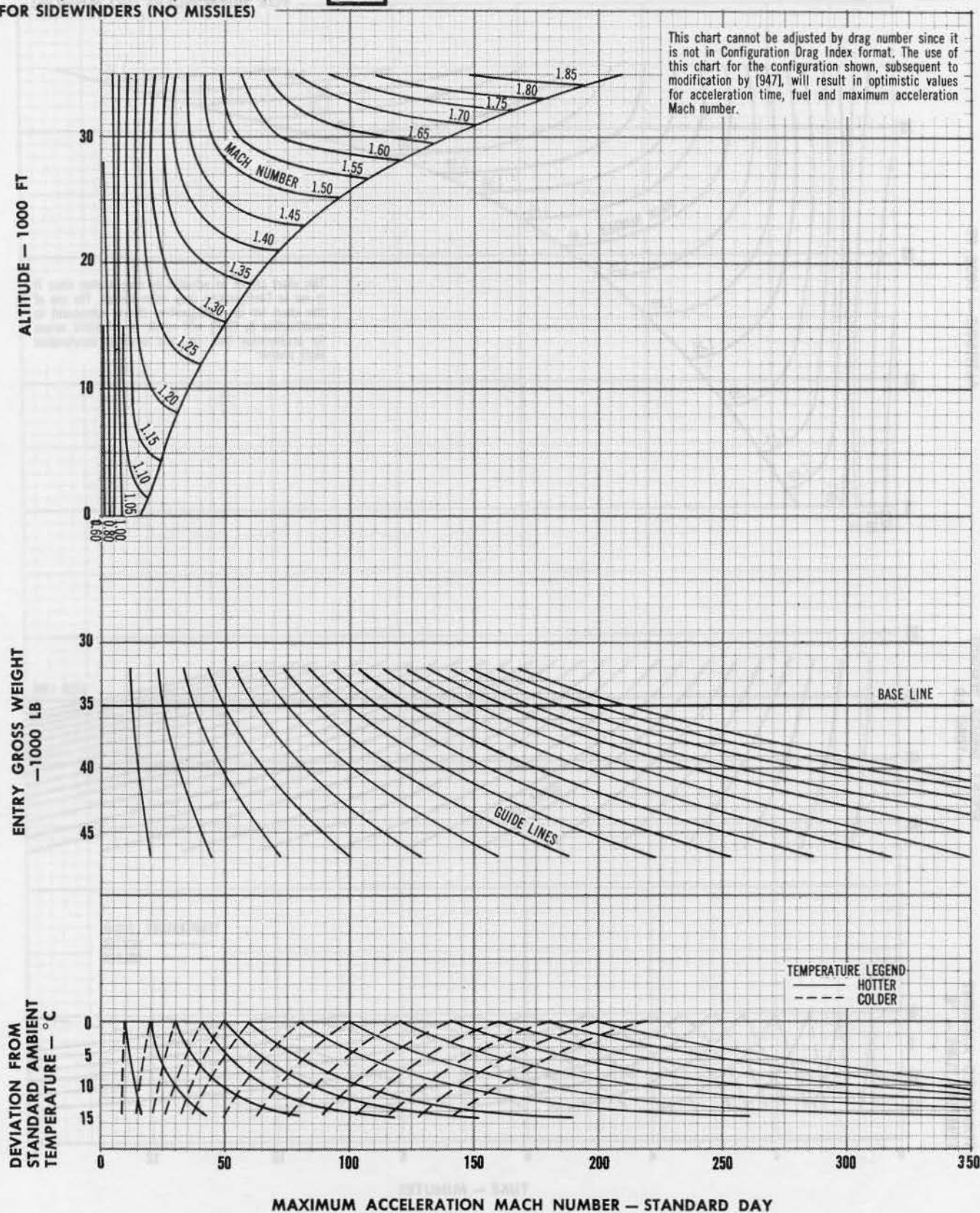


Figure B5A-5 (Sheet 2 of 3)

Model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST

F

MAXIMUM THRUST ACCELERATION TIME
CLEAN + (2) PYLONS + ADAPTERS
FOR SIDEWINDERS (NO MISSILES)

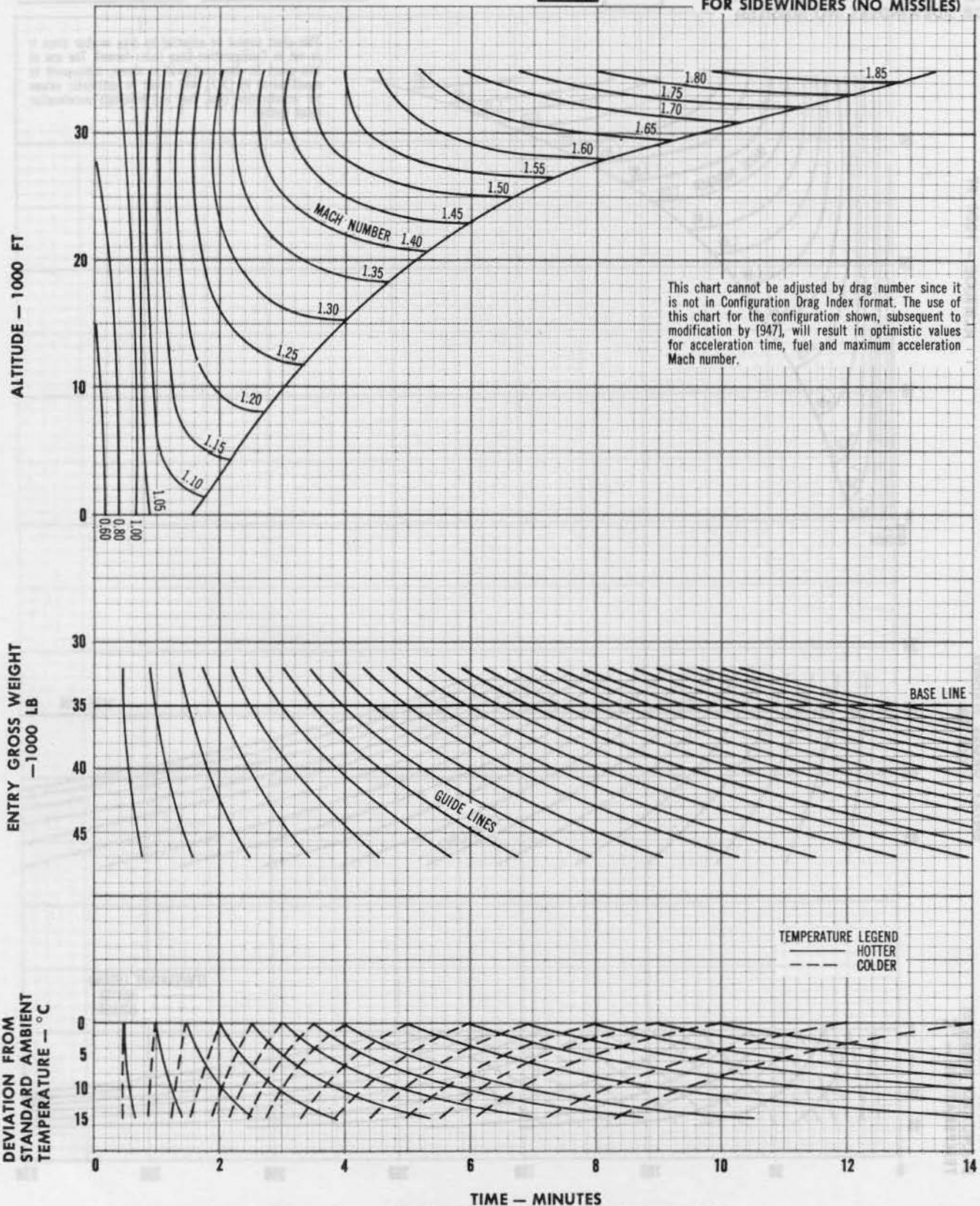


Figure B5A-5 (Sheet 3 of 3)

**MILITARY THRUST ACCELERATION
FUEL
CLEAN**

F

Model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST

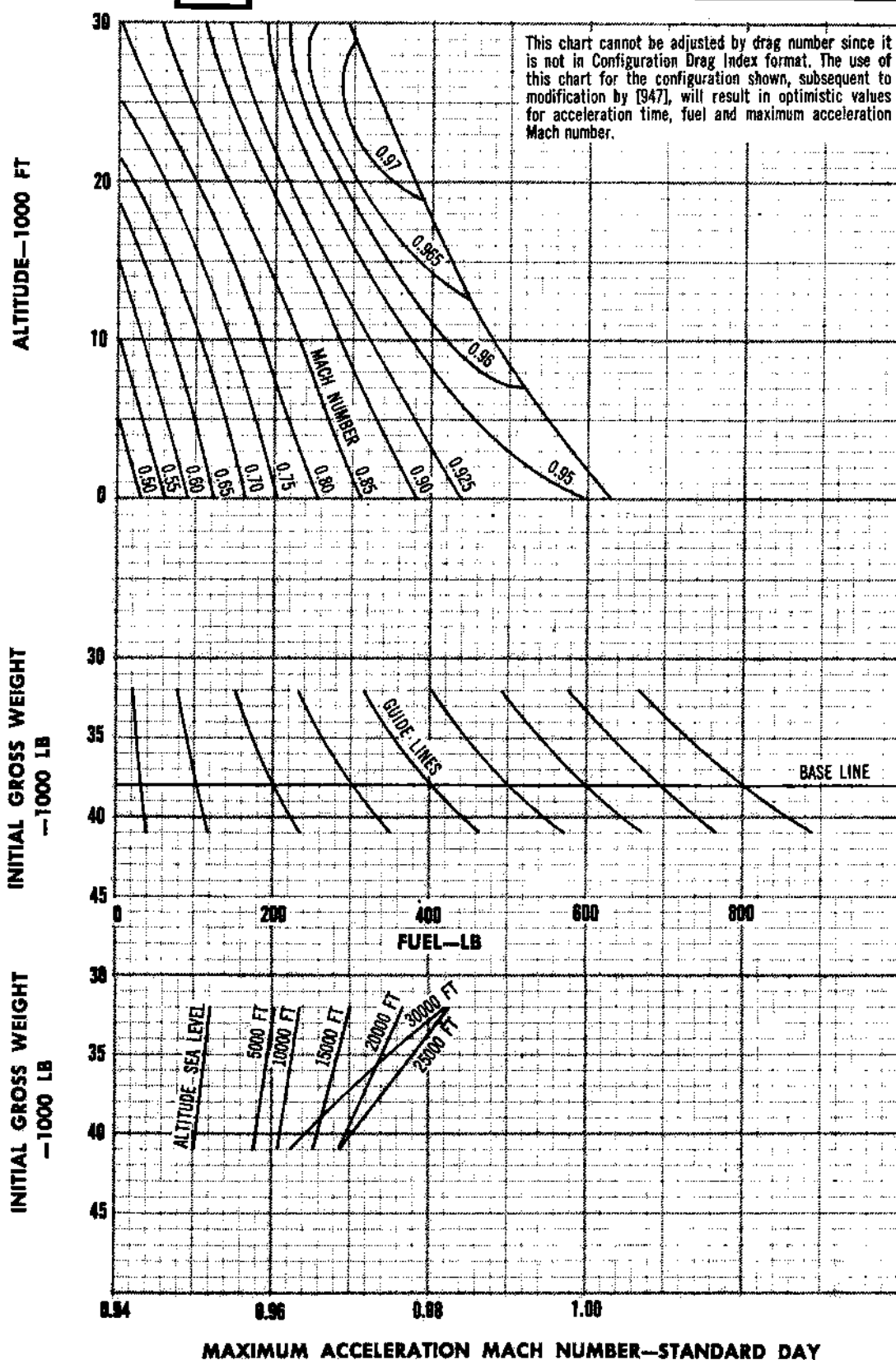


Figure B5A-6 (Sheet 1 of 3)

Model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST



**MILITARY THRUST ACCELERATION
DISTANCE
CLEAN**

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

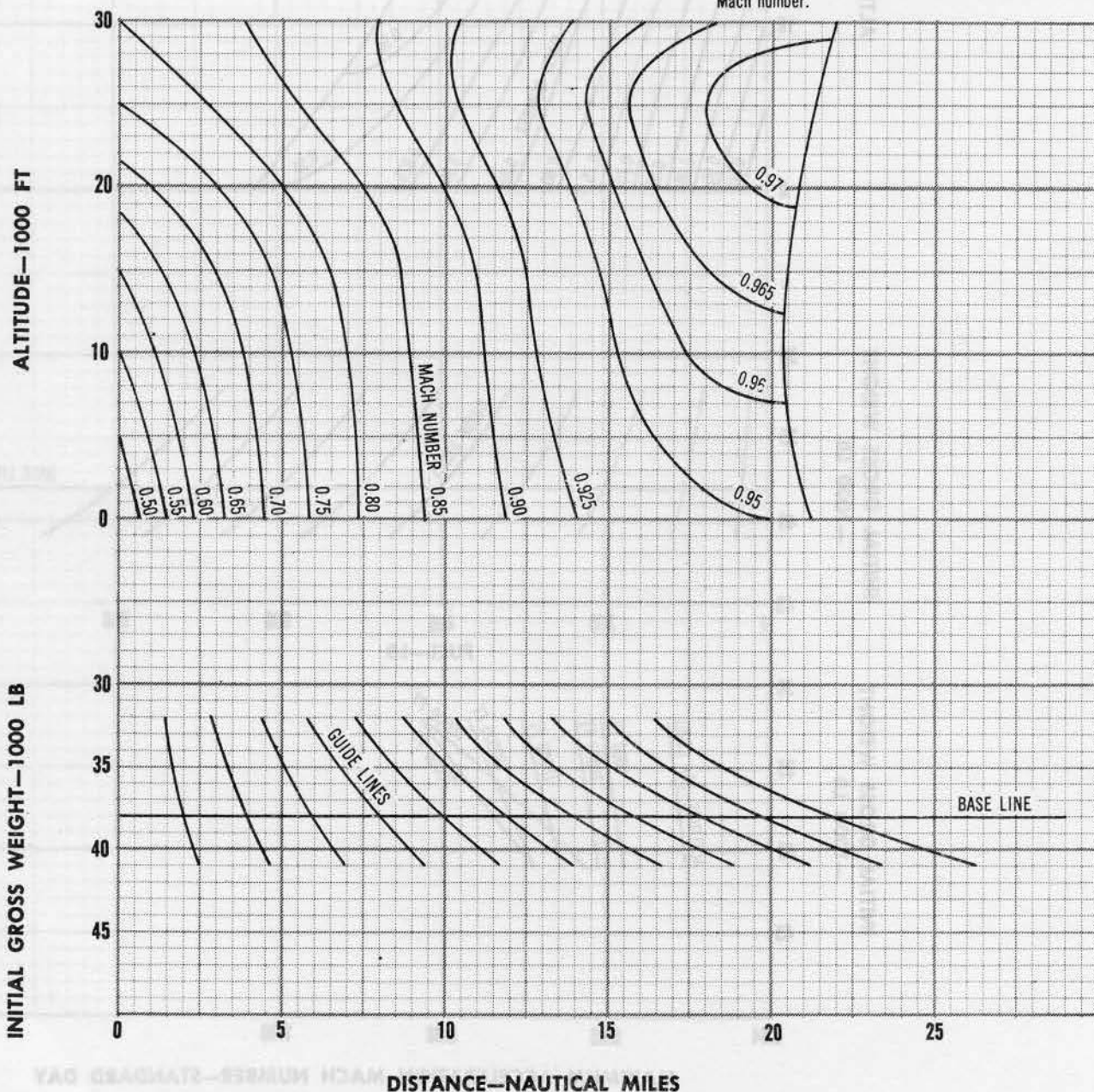


Figure B5A-6 (Sheet 2 of 3)

MILITARY THRUST ACCELERATION
TIME
CLEAN



Model:	F-105F
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 JULY 1964
data basis:	FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

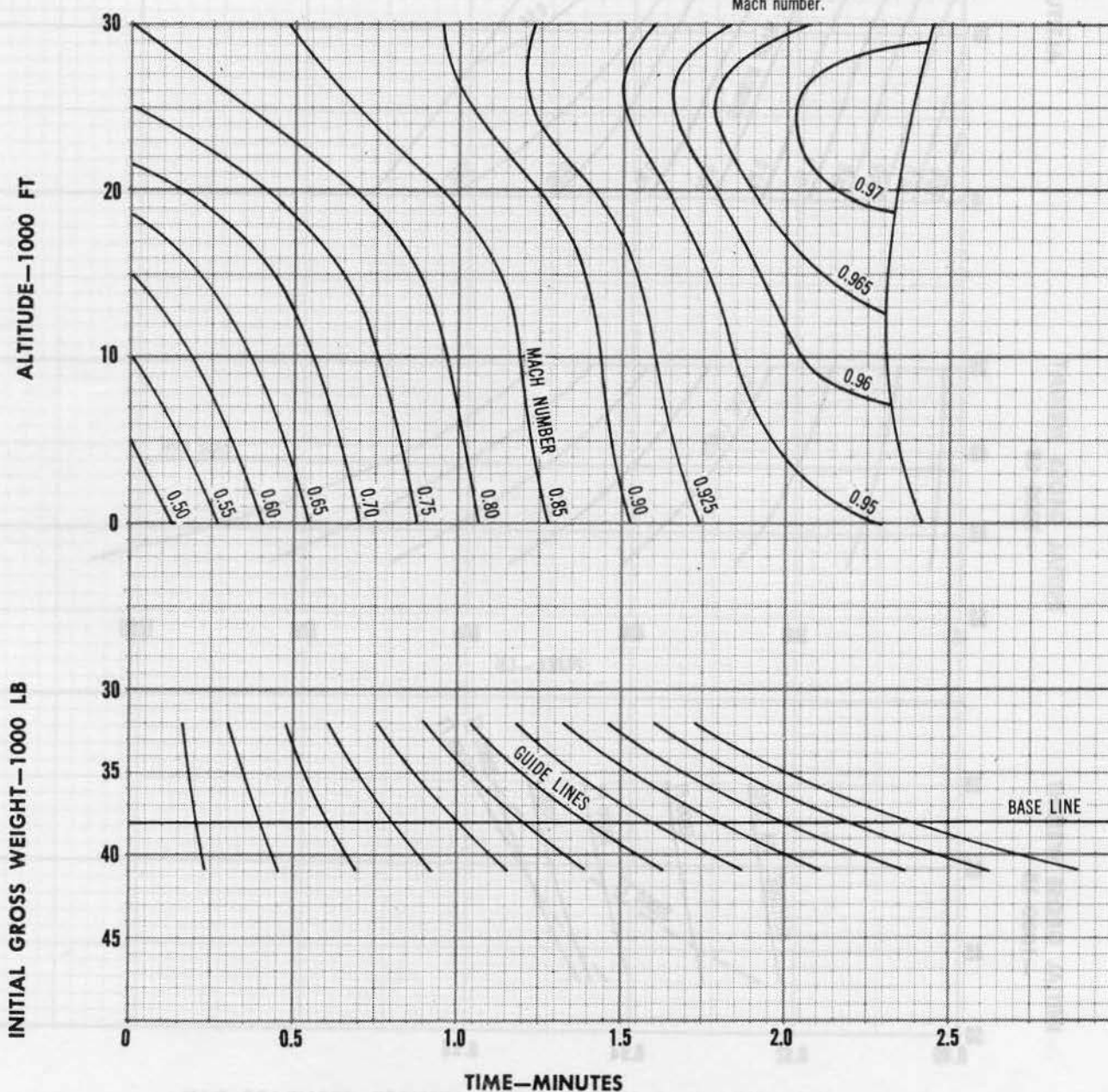


Figure B5A-6 (Sheet 3 of 3)

Model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST



**MILITARY THRUST ACCELERATION
FUEL
CLEAN + (2) 450 GAL TANKS**

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by (947), will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

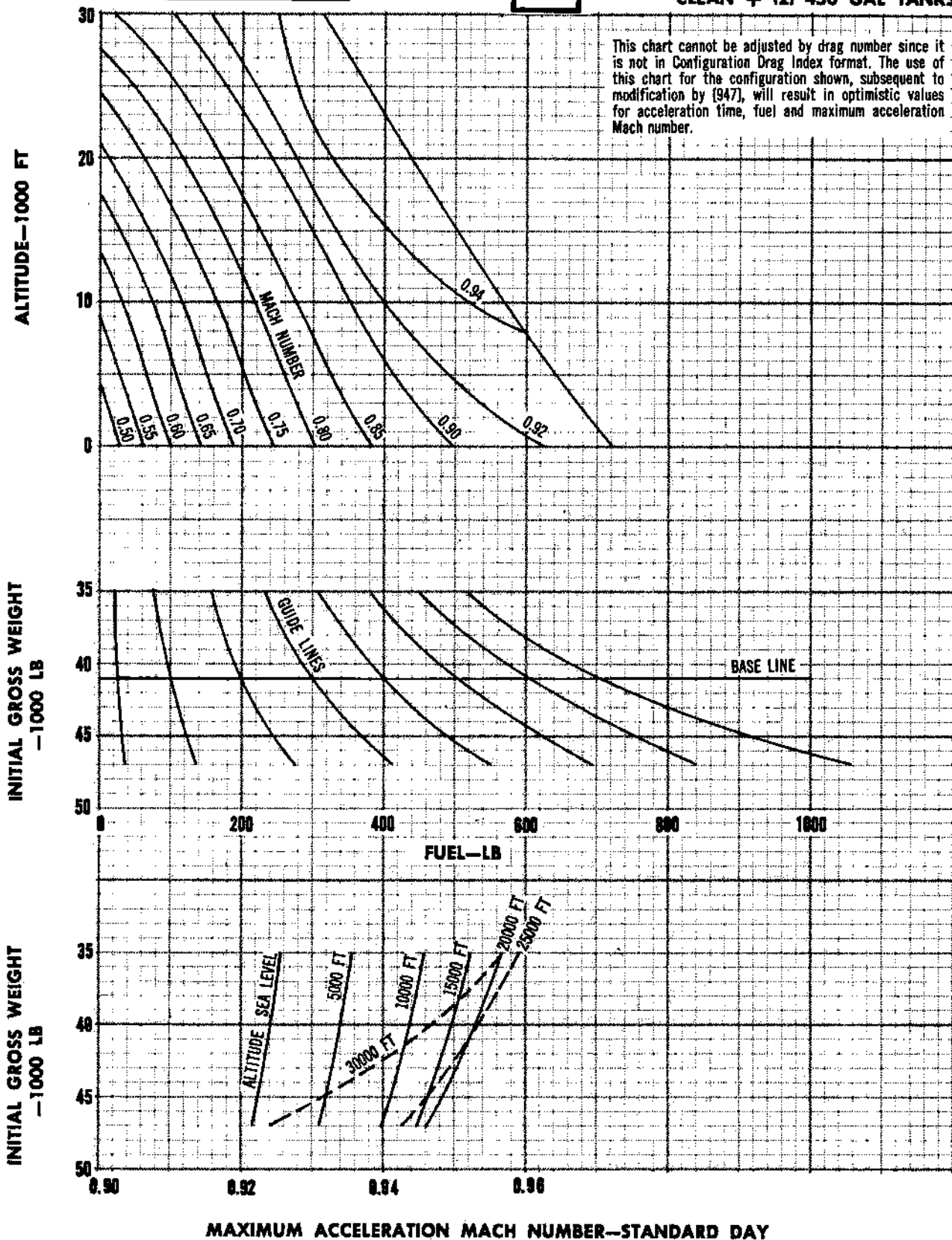


Figure B5A-7 (Sheet 1 of 3)

MILITARY THRUST ACCELERATION DISTANCE

CLEAN + (2) 450 GAL TANKS



Model:	F-105F
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 JULY 1964
data basis:	FLIGHT TEST

It is noted that this chart is based on the assumption that the aircraft is in a clean configuration and that the fuel tanks are full. The use of this chart for other configurations or fuel tank status will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

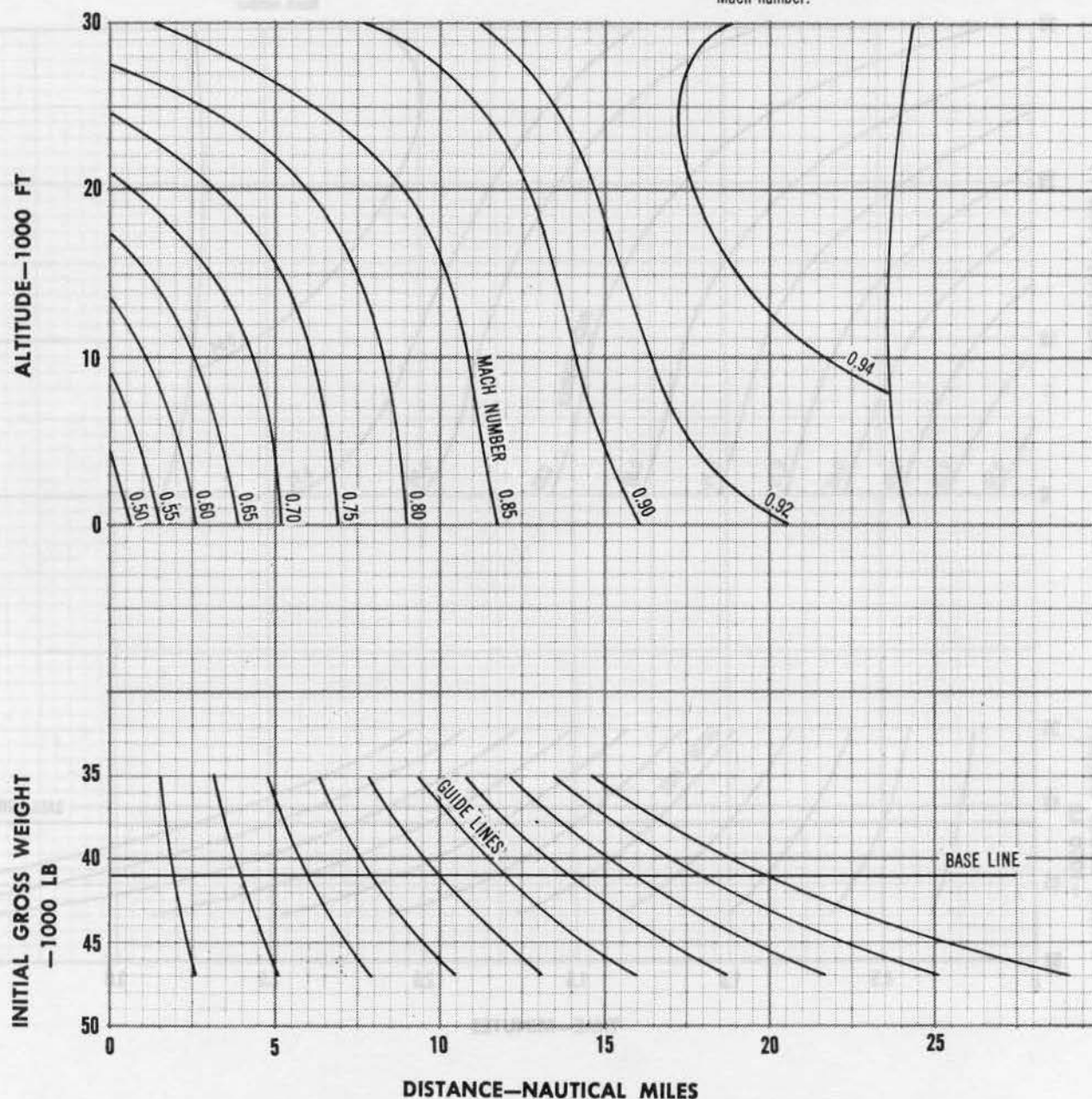
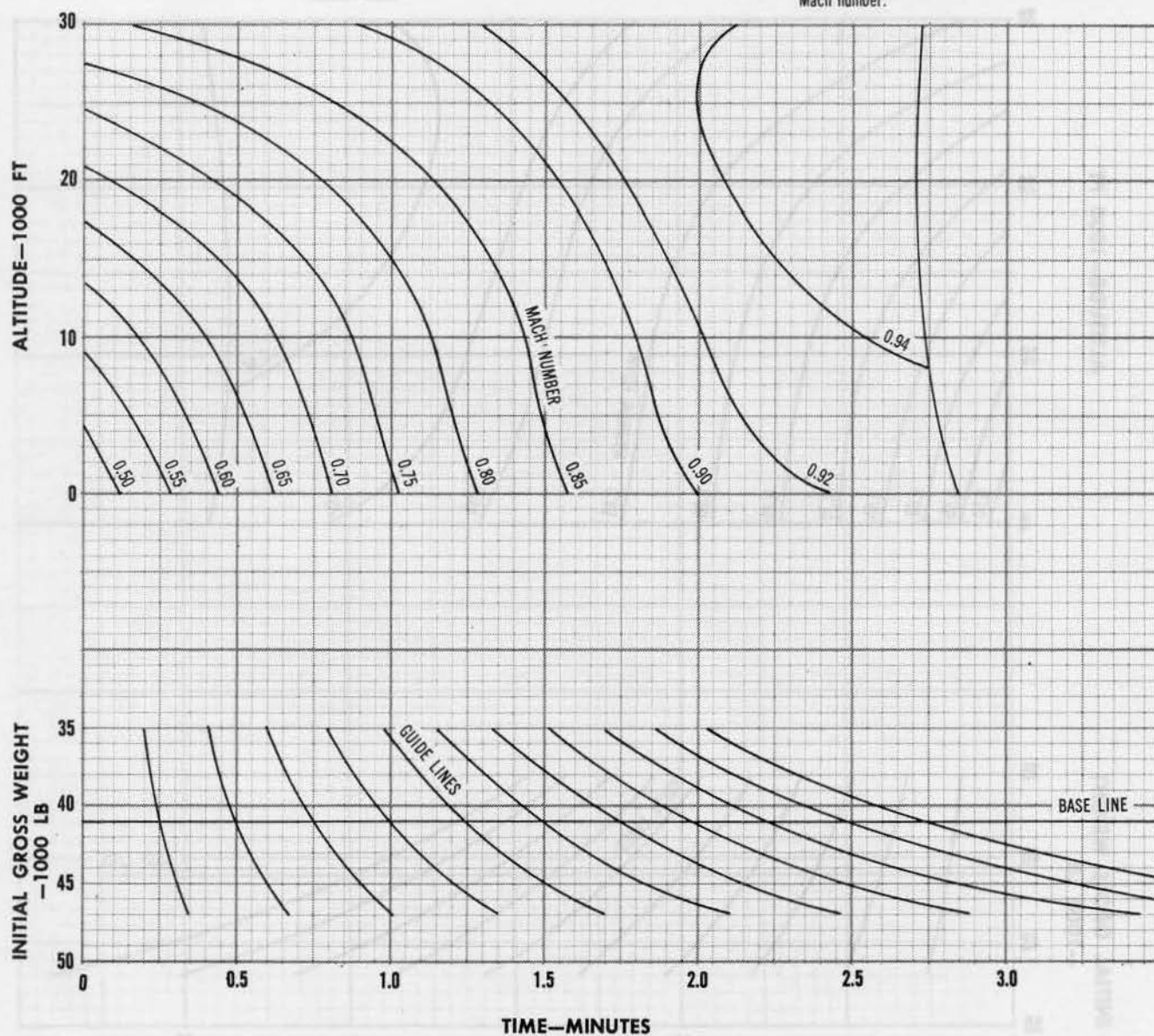


Figure B5A-7 (Sheet 2 of 3)

Model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST



**MILITARY THRUST ACCELERATION
 TIME**
CLEAN + (2) 450 GAL TANKS



This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

Figure B5A-7 (Sheet 3 of 3)

MILITARY THRUST ACCELERATION — FUEL
CLEAN + CENTERLINE 650 GAL
TANK + (2) 450 GAL TANKS



Model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number

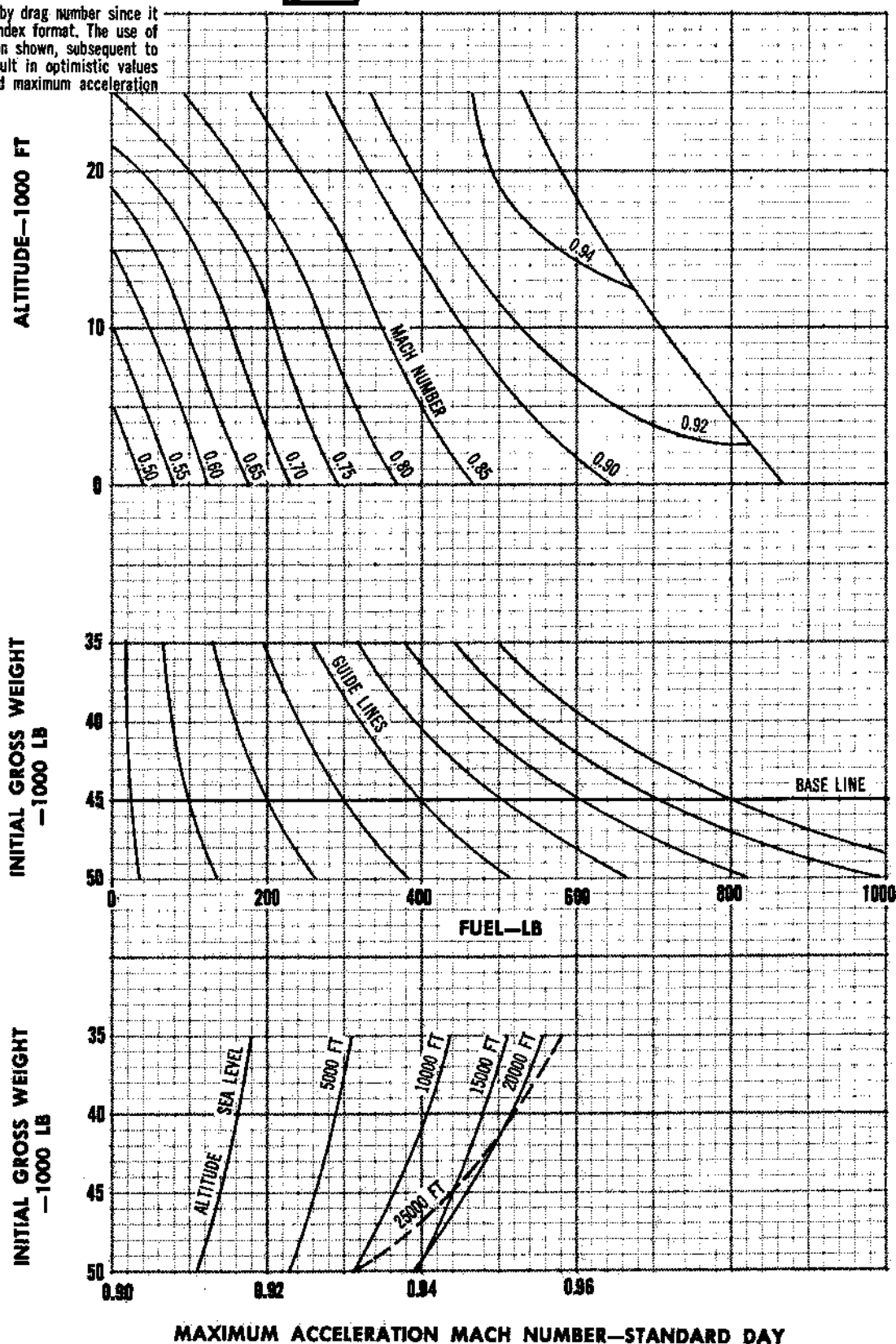


Figure B5A-8 (Sheet 1 of 3)

Model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

F

MILITARY THRUST ACCELERATION DISTANCE

CLEAN + CENTERLINE 650 GAL
TANK + (2) 450 GAL TANKS

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

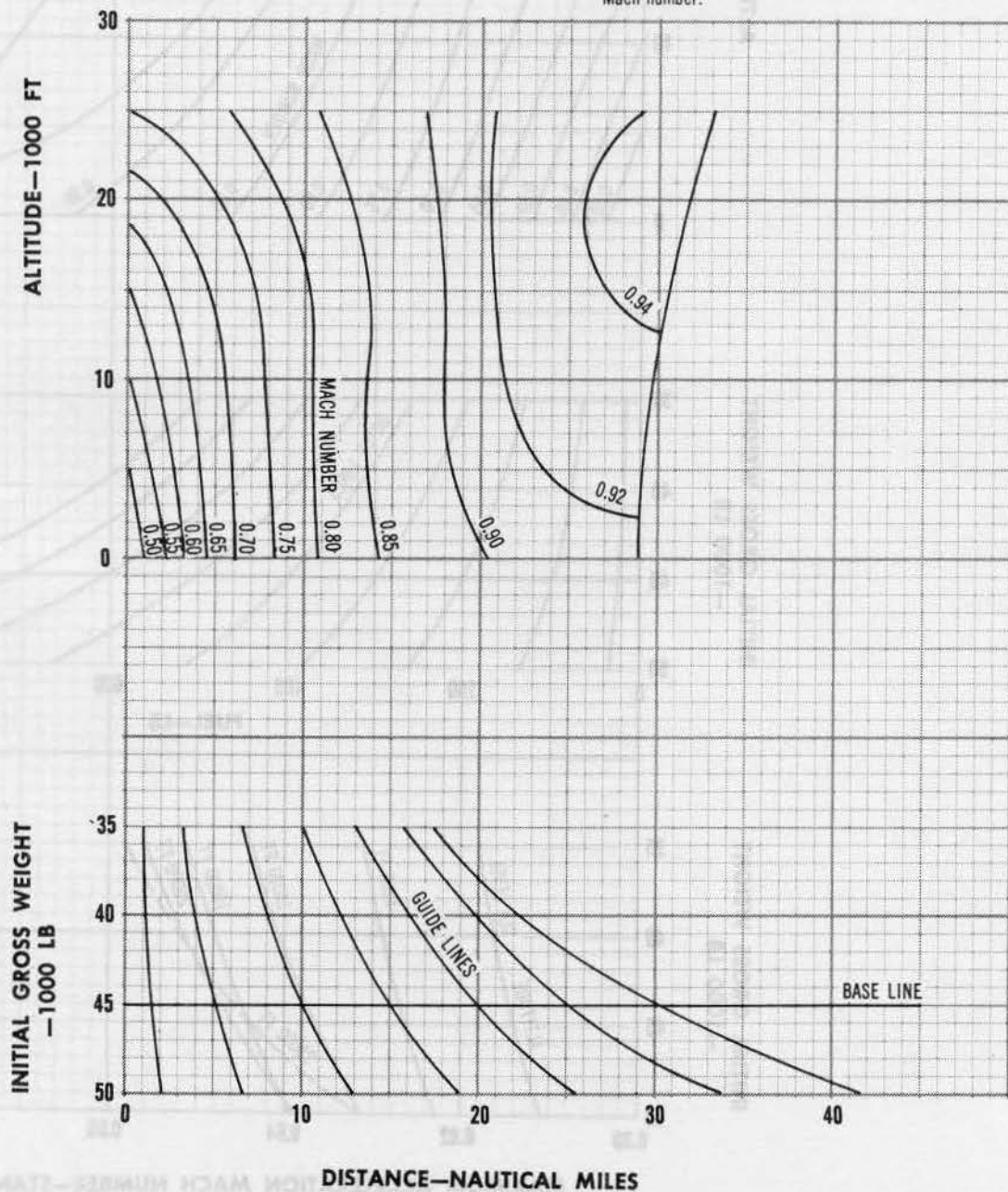


Figure B5A-8 (Sheet 2 of 3)

**MILITARY THRUST ACCELERATION
TIME**

CLEAN + CENTERLINE 650 GAL
TANK + (2) 450 GAL TANKS



Model:	F-105F
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 JULY 1964
data basis:	FLIGHT TEST

This chart cannot be adjusted by drag number since it is not in Configuration Drag Index format. The use of this chart for the configuration shown, subsequent to modification by [947], will result in optimistic values for acceleration time, fuel and maximum acceleration Mach number.

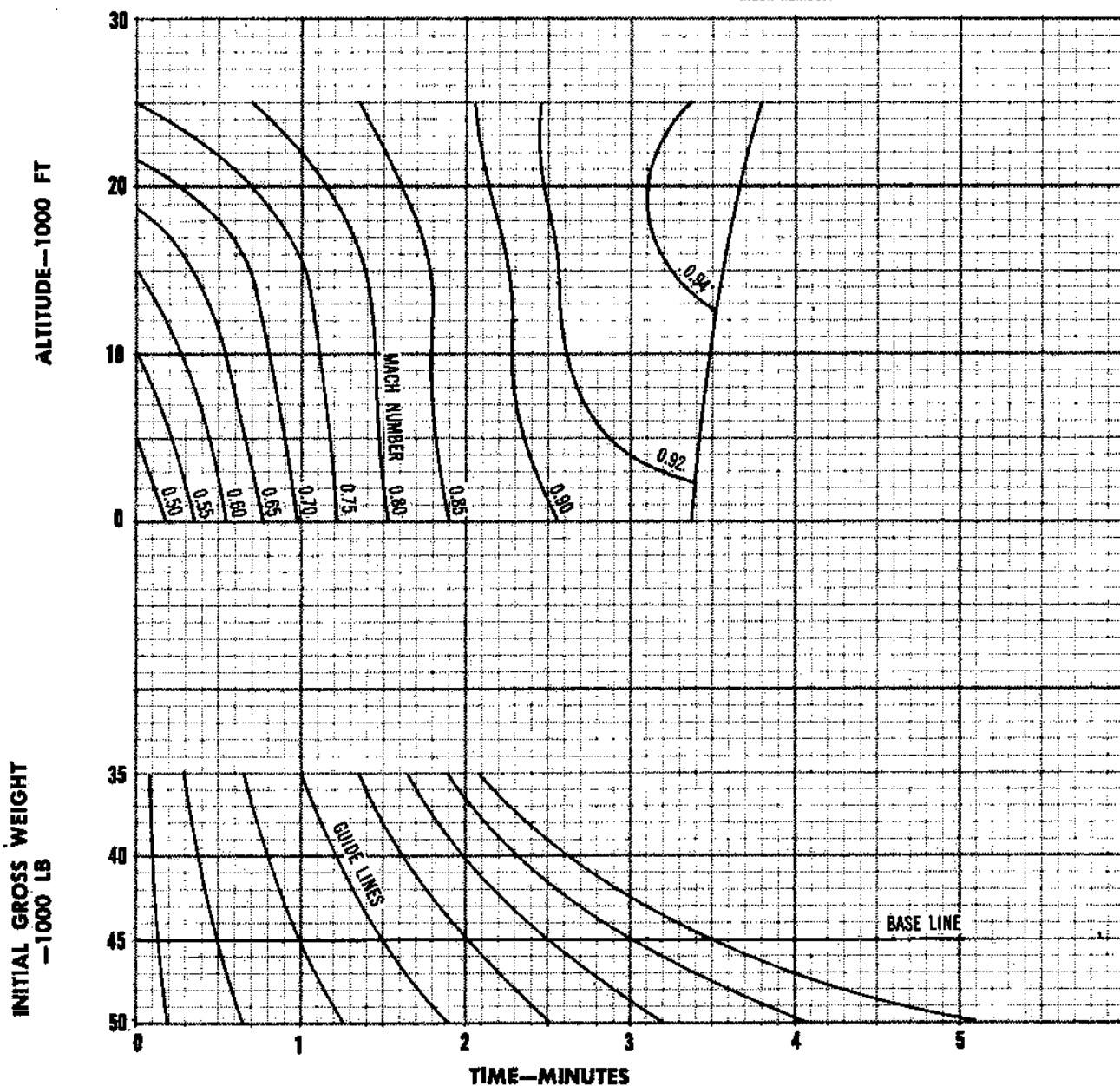


Figure B5A-8 (Sheet 3 of 3)

PART 6 AIR REFUELING

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Air Refueling Charts	B6-1, B6-2
Formating Speeds and Altitudes	B6-6
Receiver Fuel Consumption	B6-7
Fuel Transfer Time	B6-9

AIR REFUELING CHARTS: KC-135A/F-105D

Refueling data is provided in three charts: maximum formating speeds and altitudes, receiver fuel consumption, and transfer time during air refueling. The maximum formating chart is based on the receiver operating at Military Thrust at maximum gross weight (full-up condition) and the tanker at Maximum-Continuous Thrust. This chart can be read for any receiver weight and configuration, for any tanker weight, and for ambient temperatures from Standard Day conditions to 15° C hotter than standard.

The fuel flow of the receiver while in the refueling position is available from the fuel consumption chart for any combination of refueling altitude, speed, receiver weight and configuration, tanker weight and ambient temperature.

The transfer time chart provides data on maximum transfer rates and the relation between net transfer rates, transfer time and total fuel transferred.

EXAMPLE:

Determine formating altitude and speed, receiver fuel flow and transfer time to refuel the F-105 aircraft from the KC-135A under the following conditions:

Receiver Configuration: Clean + (2) 450 gal tanks + (4) M-117 750 lb bombs, centerline

Receiver Gross Weight: Prior to refueling: 40,000 lb

Receiver Gross Weight: After refueling 47,000 lb

Tanker Gross Weight: 200,000 lb

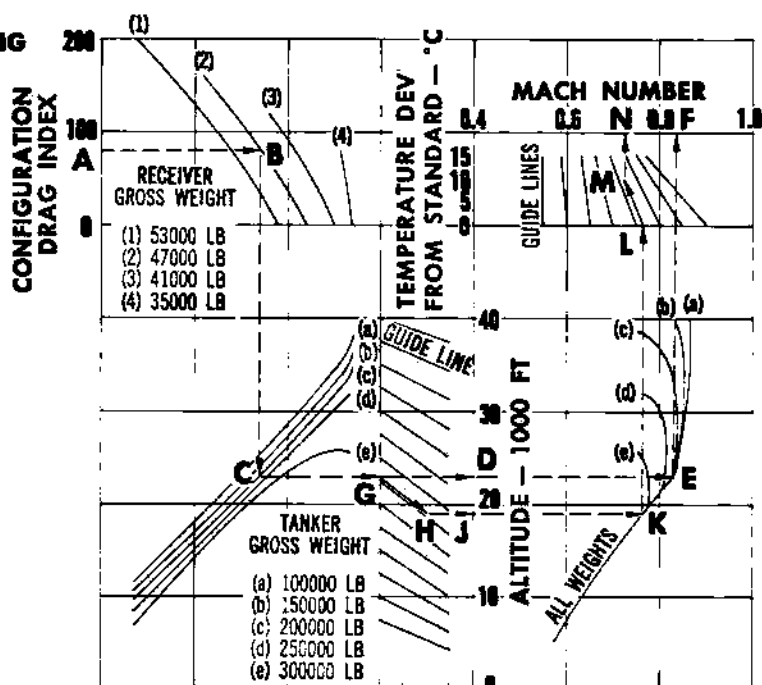
Formating Speed and Altitude

1. Ambient Temperature: Standard Day

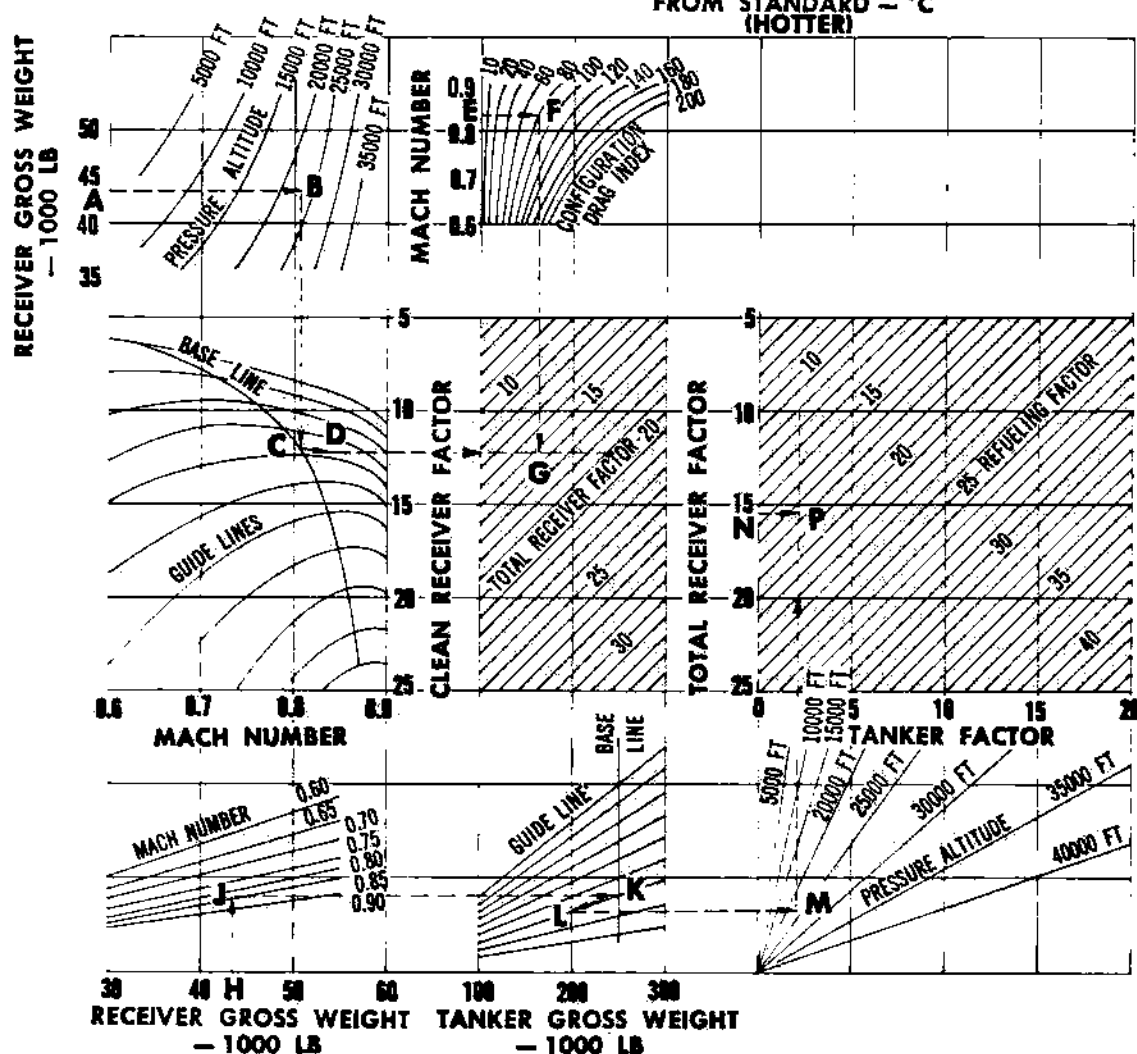
a. Determine Configuration Drag Index by adding the Store Drag numbers from figure A1-5:

F

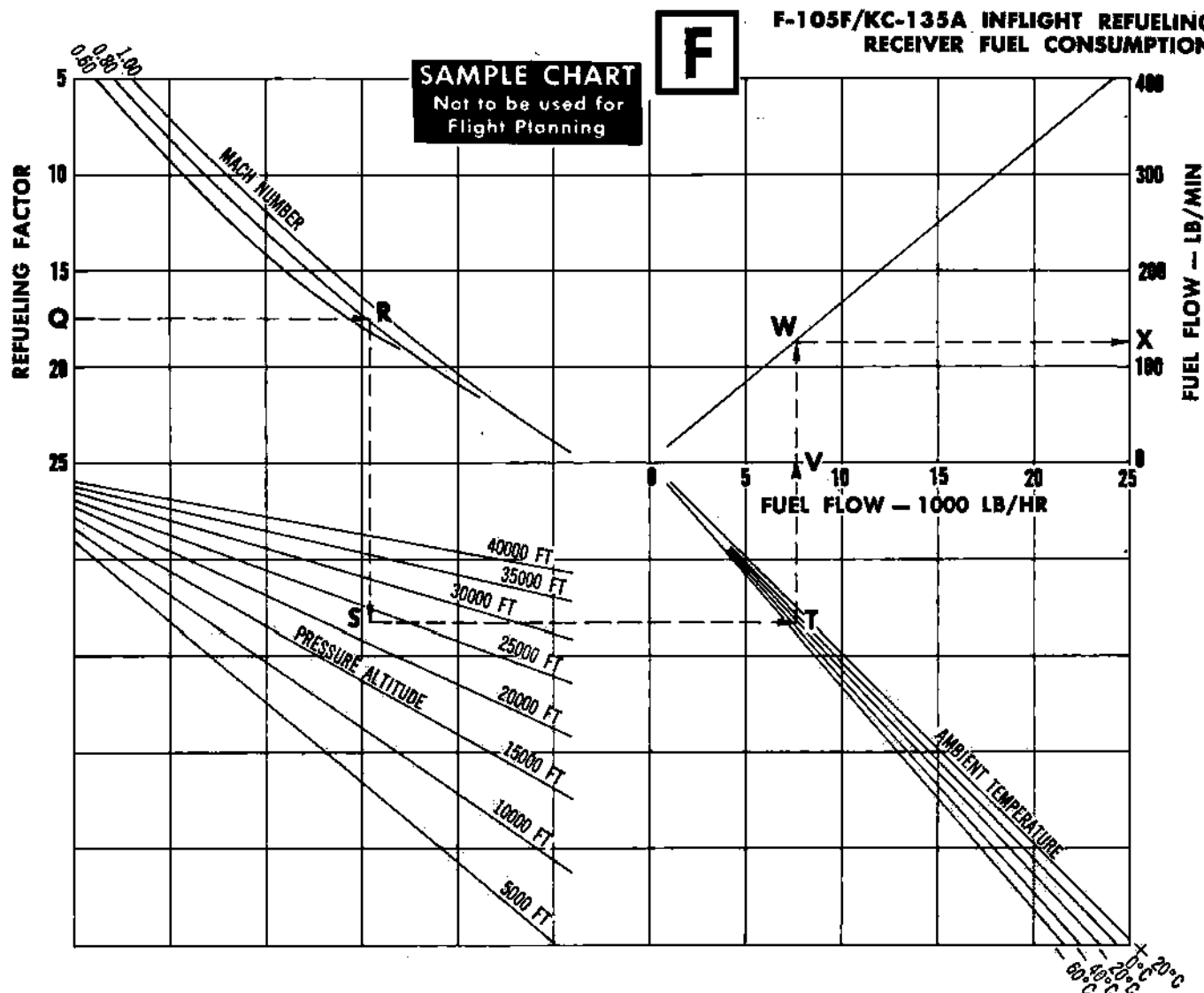
**Not to be used for
Flight Planning**



RECEIVER FUEL CONSUMPTION



**F-105F/KC-135A INFLIGHT REFUELING
RECEIVER FUEL CONSUMPTION**



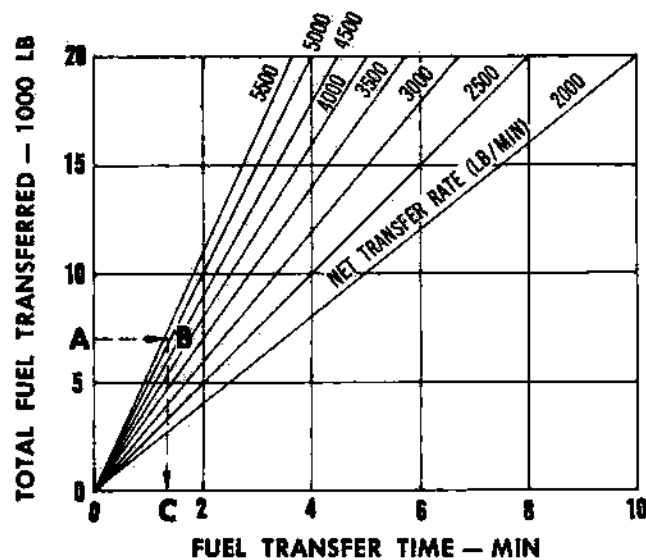
MAXIMUM FUEL TRANSFER RATES

RECEIVER FUEL CONFIGURATION	TRANSFER RATE: LB/MIN*	
	NO BOMB BAY TANK	WITH BOMB BAY TANK
NO EXTERNAL FUEL TANK	3380	4160
CENTERLINE FUSELAGE TANK ONLY	4290	5135
TWO WING - PYLON TANKS ONLY	4615	5330
TWO WING - PYLON TANKS PLUS FUSELAGE TANK	4940	5525

*ASSUMING CONSTANT 55 PSI AT NOZZLE.

ESTIMATED NET TRANSFER RATE=MAXIMUM FUEL TRANSFER RATE (ABOVE)
- RECEIVER FUEL FLOW (LB/MIN)

FUEL TRANSFER TIME



Store	Location	Store Drag NO.
450 gal tank	Right inb'd	14
450 gal tank	Left inb'd	14
(4) M-117 bombs	Centerline	52
Configuration Drag Index =		80

- Enter sample chart, top of page B6-2, at Configuration Drag Index = 80, (A) and move horizontally to the Receiver Gross Weight = 47,000 lb line, (B).
- Drop down to the Tanker Gross Weight = 200,000 lb line (C), and then horizontally to the altitude scale to read the forming altitude = 23,000 ft. (D).
- From (D), continue horizontally to the 200,000 lb tanker weight line, (E), and move up to the Mach number scale to read forming speed = 0.835 Mach number, (F).

2. Ambient Temperature: 10°C hotter

- From (C) move to the right to the 0° temperature deviation scale, (G) and follow the guide line until the 10°C temperature deviation vertical is intercepted at (H). Then move to the altitude scale (J) and read Forming altitude = 19,000 ft.
- Continue horizontally to the tanker weight line, (K) and then move up to the 0° temperature deviation scale, (L). Follow the guide line until the 10° temperature deviation line is intercepted at (M). Move vertically to the Mach number scale (N) and read forming speed = 0.725 Mach number.

Receiver Fuel Consumption

1. Ambient Temperature: Standard Day

- Determine Average Receiver Gross Weight during refuel: Initial gross weight = 40,000 lb.
Final Gross Weight = 47,000 lb
Average Gross Weight = $\frac{40,000 + 47,000}{2} = 43,500$ lb

- Enter sample chart, bottom of page B6-2. at receiver average gross weight = 43,500, (A), move to the left to forming altitude = 23,000 ft, (B) and drop to the base line at (C). Follow the guide lines to the forming speed = 0.835 Mach number, (D) and then draw a horizontal line, past the Clean Receiver Factor Scale.

Note

If receiver configuration is the clean aircraft, read Clean Receiver Factor, and skip Step 3. Then, in Step 5, Total Receiver Factor = Clean Receiver Factor.

- Reenter chart at the upper Mach Scale at 0.835 Mach number, (E), move across to Configuration Drag Index = 80, (F) drop down to intersect the line from (D) at (G) and read total Receiver Factor = 15.4.
 - Reenter sample chart at lower left hand scale at Average Receiver Gross Weight = 43,500 lb, (H) move up to Mach number 0.835, (J) across to Tanker Gross Weight Base Line, (K), and follow the guide line to Tanker Gross Weight = 200,000 lb at (L). Continue to the right to forming altitude = 23,000 ft (M) and draw a vertical line past the tanker factor scale.
 - Enter the total receiver factor scale at 15.4, (N), move to the right to intersect the vertical from (M) and read refueling factor = 17.5 at the intersection, (P).
 - Enter sample chart, top of page B6-3, at refueling factor = 17.5, (Q), move to the left to forming speed = 0.835 (R), and drop down to altitude = 23,000 ft, (S).
 - From the Standard Atmosphere Chart, figure B1-10, the Standard Day Temperature at 23,000 ft = 30.6°C. Move right from (S) to -30.6°C, at (T), and up to the Fuel Flow Scale at (V), to read receiver fuel flow = 7600 lb/hr. Continue up to line at (W) and to the right to (X) for the conversion to lb/min, and read receiver fuel flow = 127 lb/min.
- ### 2. Ambient Temperature: 10°C hotter than Standard
- The same procedure as in step 1a is followed, using the forming altitude and speed developed in Formating Speed and Altitude, step 2 for pressure altitude and Mach number.

When Standard Day Temperature is read from figure B1-10, add 10°C and then continue as in step 1.

Transfer Time

1. Enter table on sample chart, bottom of page B6-3, for Receiver fuel configuration with two wing-pylon tanks, with Bomb Bay Tank. and read maximum fuel transfer rate = 5330 lb/min. Compute net transfer rate = 5330 - 127 (Receiver Fuel Consumption, step 1g) = 5203 lb/min.

2. Total fuel transferred = Final Receiver Weight minus Initial Receiver Weight = 7000 lb. Enter the total fuel transferred scale at 7000 lb. (A) move to the right to net transfer rate = 5203 lb/min, (B) and drop down to scale at (C) to read fuel transfer time = 1.35 min.

Note

This chart may also be used to determine total fuel transferable in a given time, by entering at the fuel transfer time, to an estimated net transfer rate and reading total fuel transferred.

model: KC-135A
 engine: J57-P-59W & -43WB
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST
 thrust: MAX CONTINUOUS

Model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST
 thrust: MILITARY

FORMATING SPEEDS AND ALTITUDES

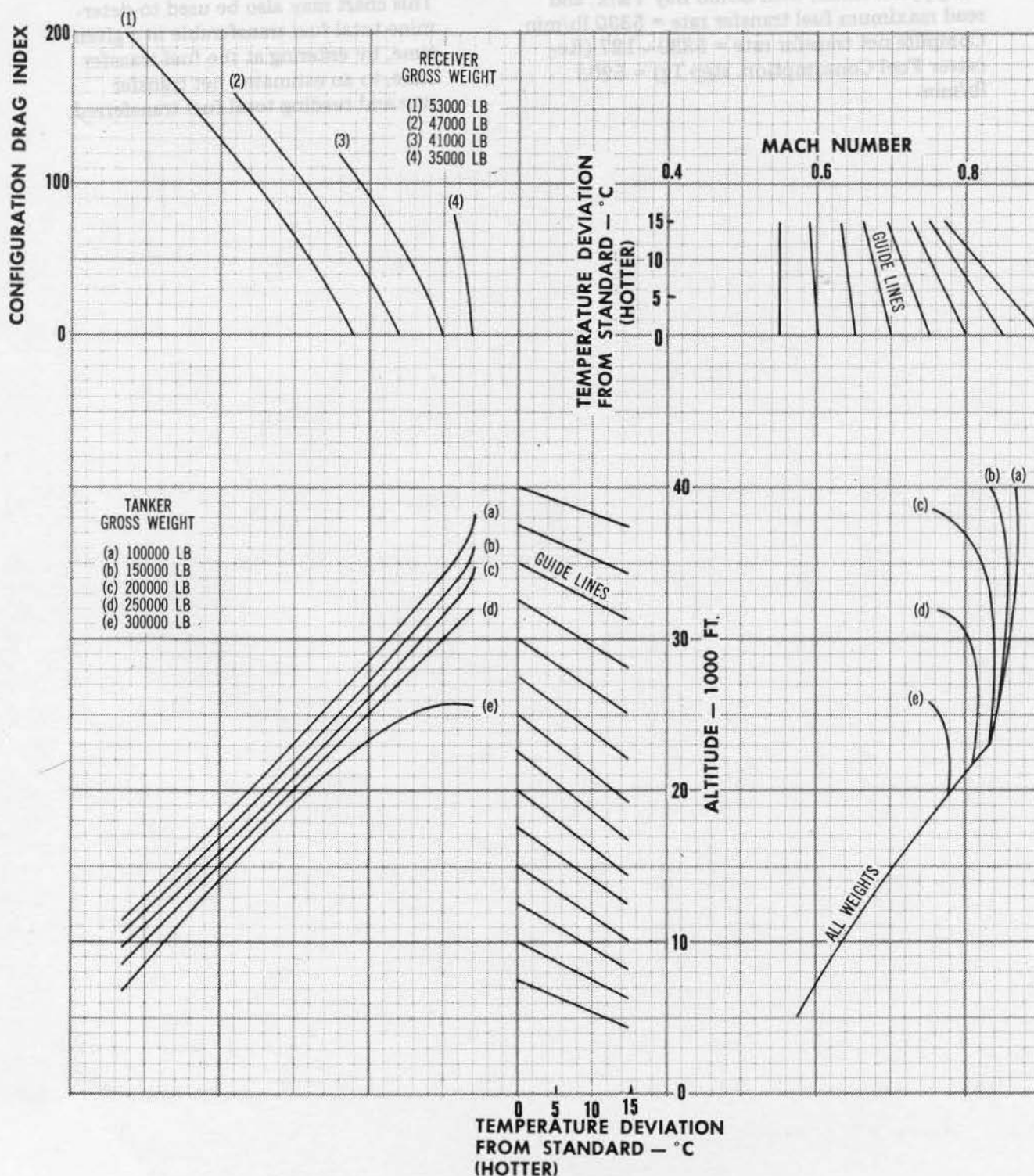


Figure B6-1

F-105F/KC-135A INFLIGHT REFUELING RECEIVER FUEL CONSUMPTION



model:	F-105F
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 JULY 1964
data basis:	FLIGHT TEST

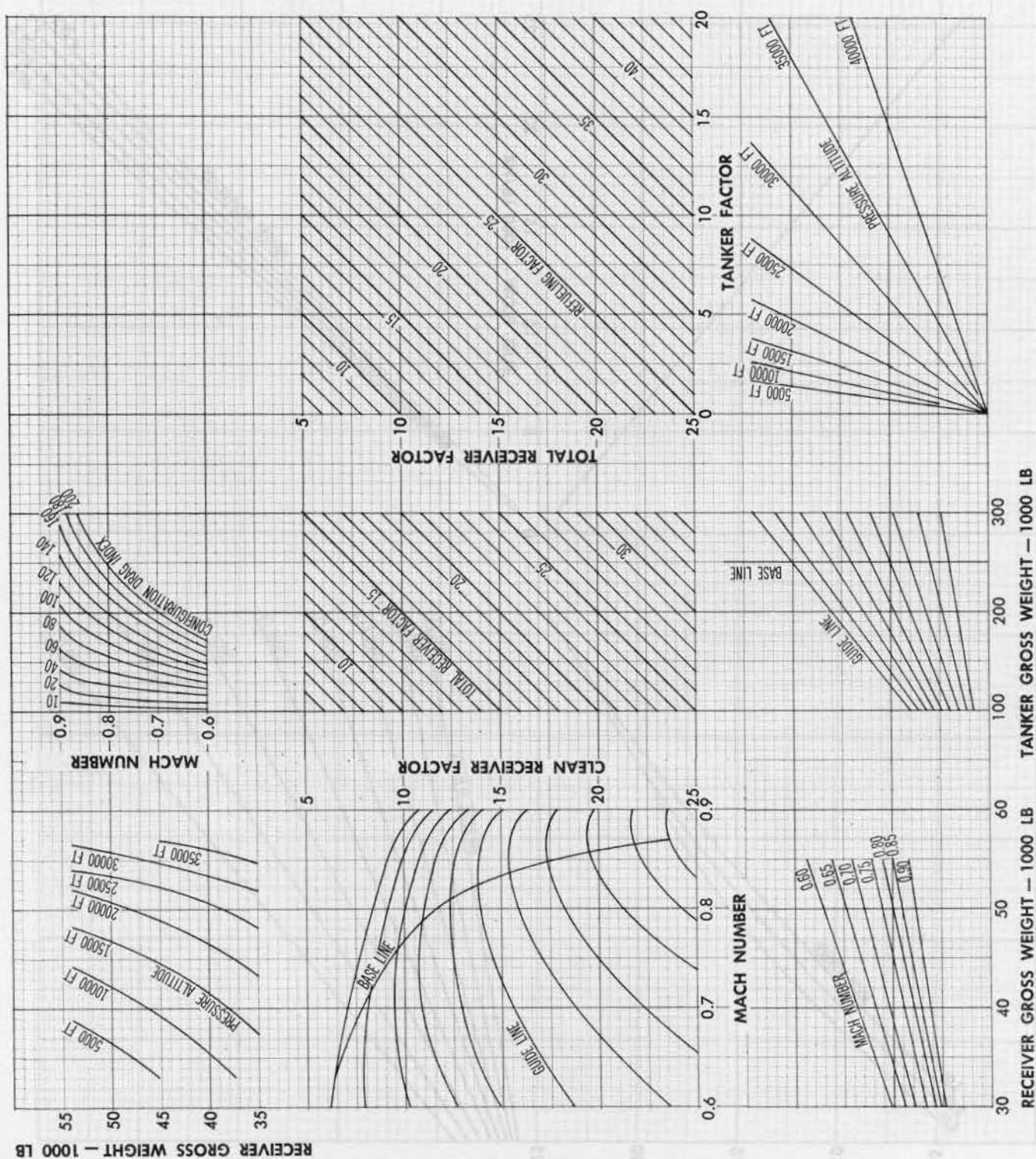


Figure B6-2 (Sheet 1 of 2)

model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST



**F-105F/KC-135A INFLIGHT REFUELING
RECEIVER FUEL CONSUMPTION**

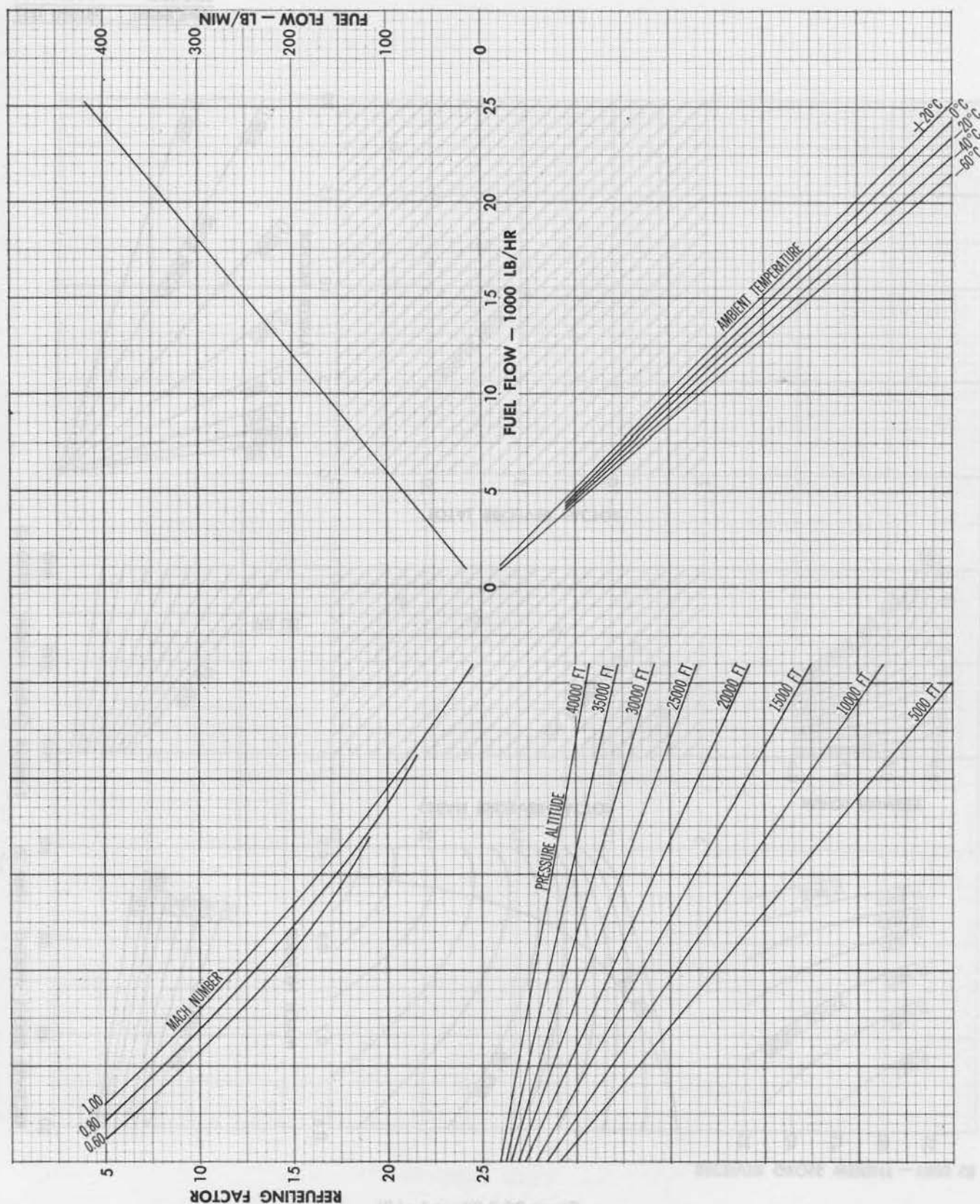


Figure B6-2 (Sheet 2 of 2)

**F-105F/KC-135A INFLIGHT REFUELING
FUEL TRANSFER TIME**


model: KC-135A
 engine: J57-P-59W & -43WB
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 FEB 1963
 data basis: FLIGHT TEST
 thrust: MAX CONTINUOUS

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST
 thrust: MILITARY

MAXIMUM FUEL TRANSFER RATES

RECEIVER FUEL CONFIGURATION	TRANSFER RATE: LB/MIN*	
	NO BOMB BAY TANK	WITH BOMB BAY TANK
NO EXTERNAL FUEL TANK	3380	4160
CENTERLINE FUSELAGE TANK ONLY	4290	5135
TWO WING — PYLON TANKS ONLY	4615	5330
TWO WING — PYLON TANKS PLUS FUSELAGE TANK	4940	5525

*ASSUMING CONSTANT 55 PSI AT NOZZLE.

ESTIMATED NET TRANSFER RATE=MAXIMUM FUEL TRANSFER RATE (ABOVE) — RECEIVER FUEL FLOW (LB/MIN)

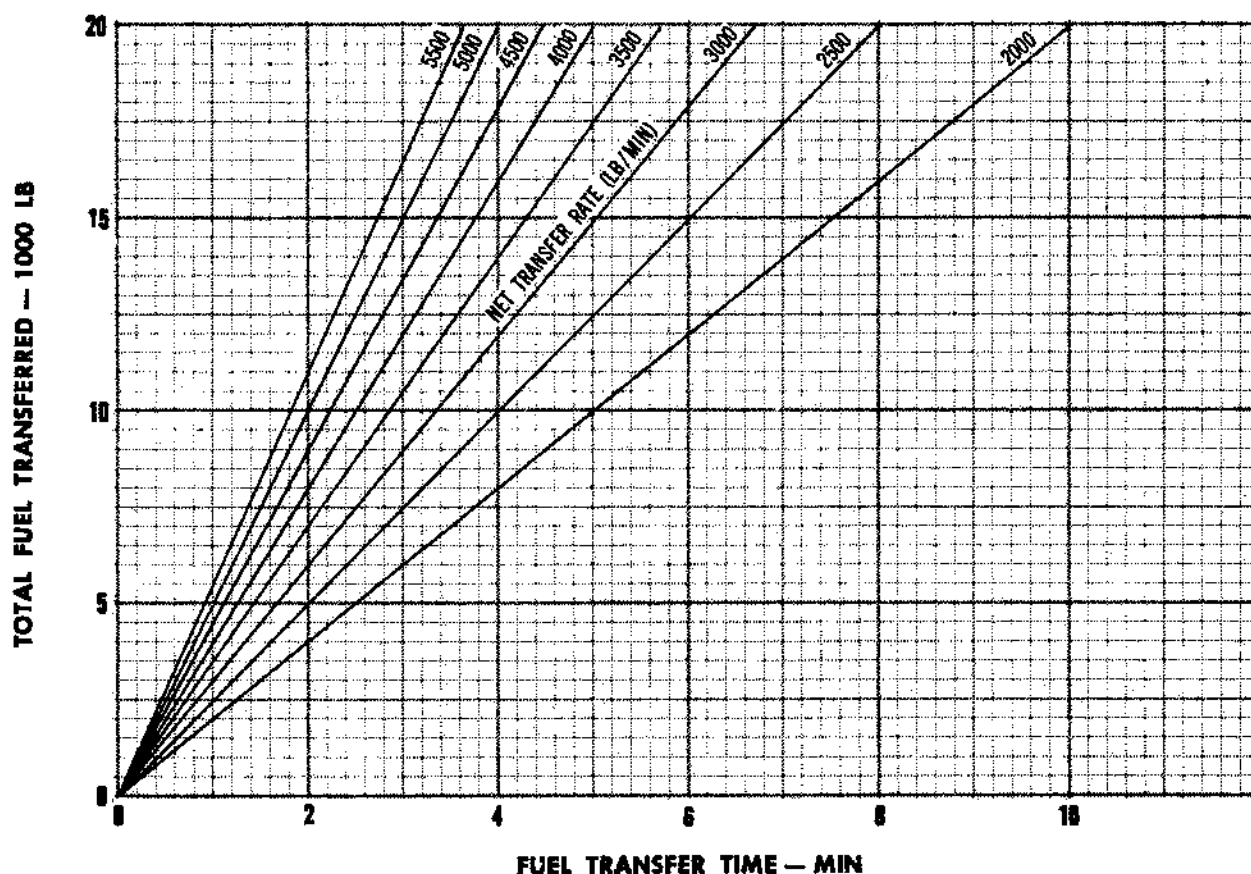


Figure B6-3

PART 7 DESCENT

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Maximum Range Descent Charts	B72, B7-5
Combat Descent Chart	B7-7
Penetration Descent Chart	B7-8

DESCENT INFORMATION.

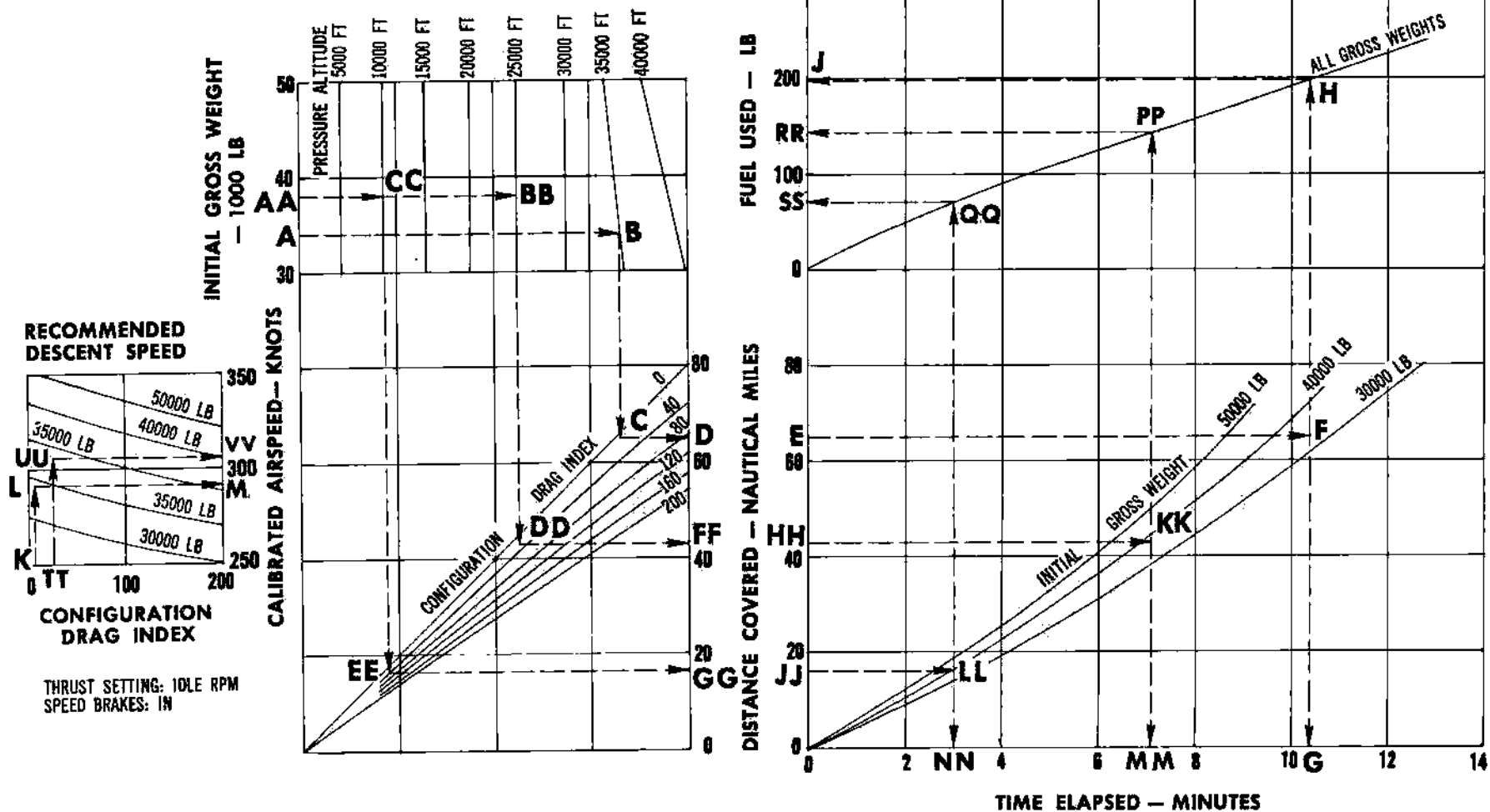
The Descent Charts enable the pilot to determine the fuel used, distance covered and time elapsed in any one of the three types of descent, between any two altitudes, at any conditions of aircraft weight and configuration. The descent schedules shown are:

<i>Type</i>	<i>Thrust Setting</i>	<i>Speed</i>	<i>Speed Brakes</i>
Maximum Range	Idle	Shown on Chart	In
Penetration	88%	300 KCAS	Out
Combat	Idle	0.9M or 400 KCAS whichever is less	In



SAMPLE CHART

Not to be used for
Flight Planning



EXAMPLE I

Conditions: Configuration: Clean + (2) Special AIM-9B Pylons, Outboard

Initial Gross Weight: 34,000 lb

Entry Altitude: 35,000 ft

Final Altitude: Sea Level

Find: Fuel used, distance covered and time elapsed in a maximum range descent, and the recommended descent speed.

Solution:

1. Determine the configuration drag index from Figure B1-5 by adding the various store drag numbers.

Store	Location	Store Drag NO.
(1) Special AIM-9B Pylon	Left Inb'd	3
(1) Special AIM-9B Pylon	Right Outb'd	3
Configuration Drag Index =		6

2. Enter Sample Chart page B7-2 at initial gross weight = 34,000 lb, (A) and move across to entry altitude = 35,000 ft, (B). From (B) drop down to Configuration Drag Index = 6, (C). Move to the right and read distance covered = 65 N Mi, (D).
3. Enter Sample Chart page B7-2 at distance covered in descent = 65 N Mi, (E) and move to the right to initial gross weight = 34,000 lb, (F).
4. Drop to the time scale and read time elapsed = 10.4 minutes, (G). Move up from (F) to the fuel line for all gross weights, (H), move to the left and read fuel used = 198 lb, (J).
5. To read recommended descent speed, enter sample chart page B7-2 at Configuration Drag Index = 6, (K). Move up to initial gross weight = 34,000 lb (L), and then to the right to read recommended calibrated airspeed = 292 knots, (M).

EXAMPLE II

Condition: Configuration: Clean + (2) M-117 Bombs outboard

Initial Gross Weight: 38,000 lb

Entry Altitude: 25,000 ft

Final Altitude: 10,000 ft

Find: Fuel used, distance covered and time elapsed in a maximum range descent from 25,000 ft to 10,000 ft, and the recommended descent speed.

Solution:

1. Determine the configuration drag index from the table of Figure B1-5 by adding the various store drag numbers.

Store	Location	Store Drag NO.
(1) M-117 lb Bomb	Left outboard, not in presence of inb'd store	13
(1) M-117 lb Bomb	Right outboard, not in presence of inb'd store	13
Configuration Drag Index =		26

2. Enter sample chart page B7-2 at initial gross weight = 38,000 lb, (AA). Move across to entry and final altitudes = 25,000 ft, (BB) and 10,000 ft, (CC), respectively. From (BB) and (CC) drop down to configuration drag index = 26, at (DD) and (EE) respectively. Move to the right and read distance covered = 43 N Mi, (FF) and 16 N Mi, (GG). The difference between (FF) and (GG) is the actual distance covered from the entry altitude to final altitude. Distance covered = 43 N Mi - 16 N Mi = 27 N Mi.
3. Enter sample chart page B7-2 at distance covered = 43 N Mi (HH) and 16 N Mi, (JJ). Move to the right to initial gross weight = 38,000 lb at (KK) and (LL). From (KK) and (LL) drop to the time scale and read time elapsed = 7.1 min, (MM) and 3.0 minutes, (NN).

Time elapsed from 25,000 ft to 10,000 ft =
(MM) - (NN) = 7.1 minutes - 3.0 min = 4.1
minutes.

4. From (KK) and (LL) move up to the fuel line
for all gross weights at (PP) and (QQ), respec-
tively. Move to the right and read fuel used =
143 lb, (RR) and 71 lb, (SS).

Net fuel used = RR - SS = 143 lb - 71 lb =
72 lb.

5. Summary

Distance covered = 27 N Mi

Time Elapsed = 4.1 minutes

Fuel used = 72 lb

6. To read recommended descent speed, enter
sample chart page B7-2 at configuration drag
index = 26, (TT), move up to initial gross
weight = 38,000 lb, (UU) and then to the
right to read recommended calibrated airspeed
= 306 knots, (VV).

Note

The penetration descent (88% RPM
and 300 KCAS) and combat descent
(idle RPM and M = 0.9 or 400 KCAS,
whichever is less) charts are similar
in appearance to the maximum range
descent charts and are used in the
same manner.

MAXIMUM RANGE DESCENT



model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

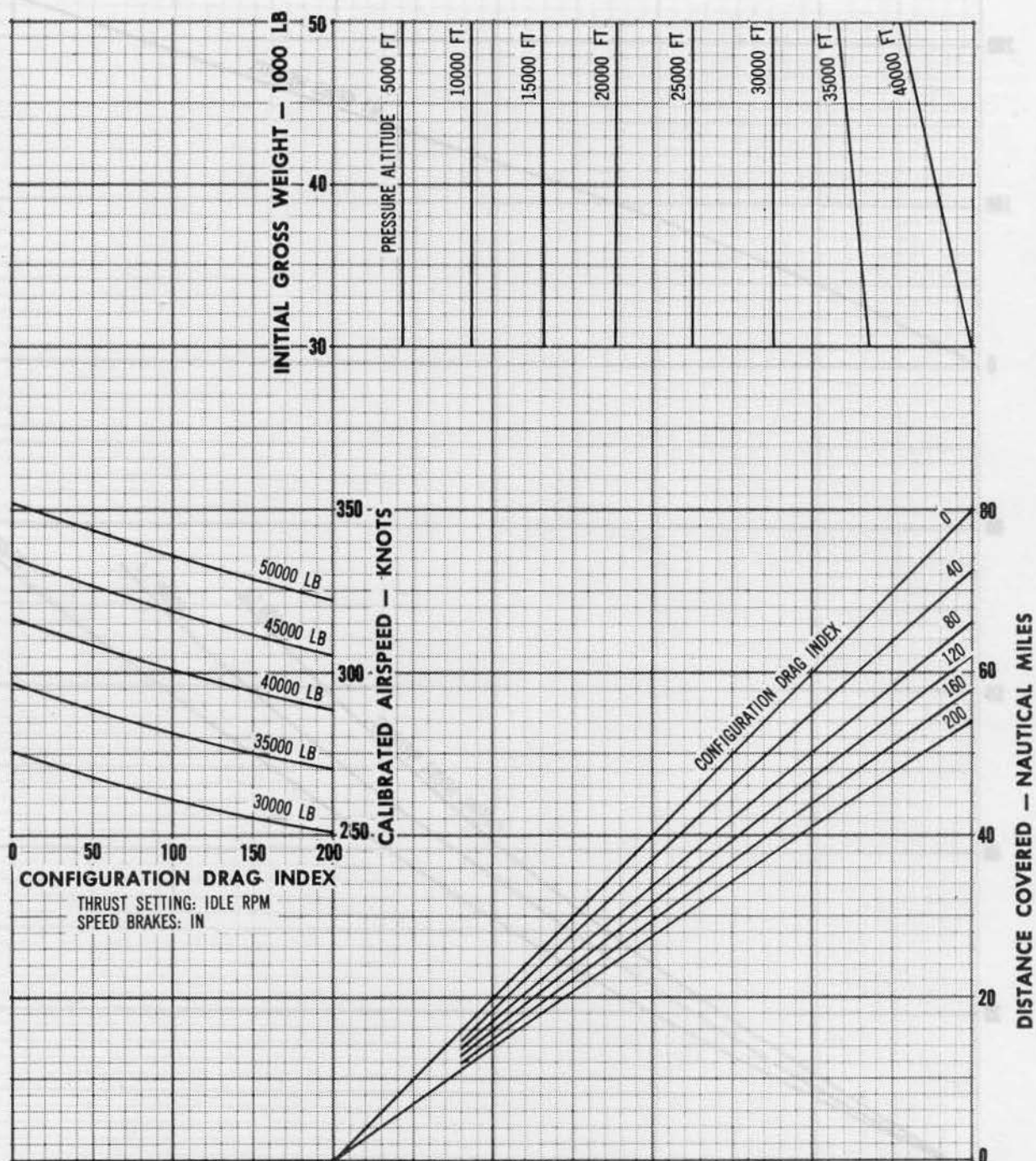


Figure B7-1 (Sheet 1 of 2)

model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST

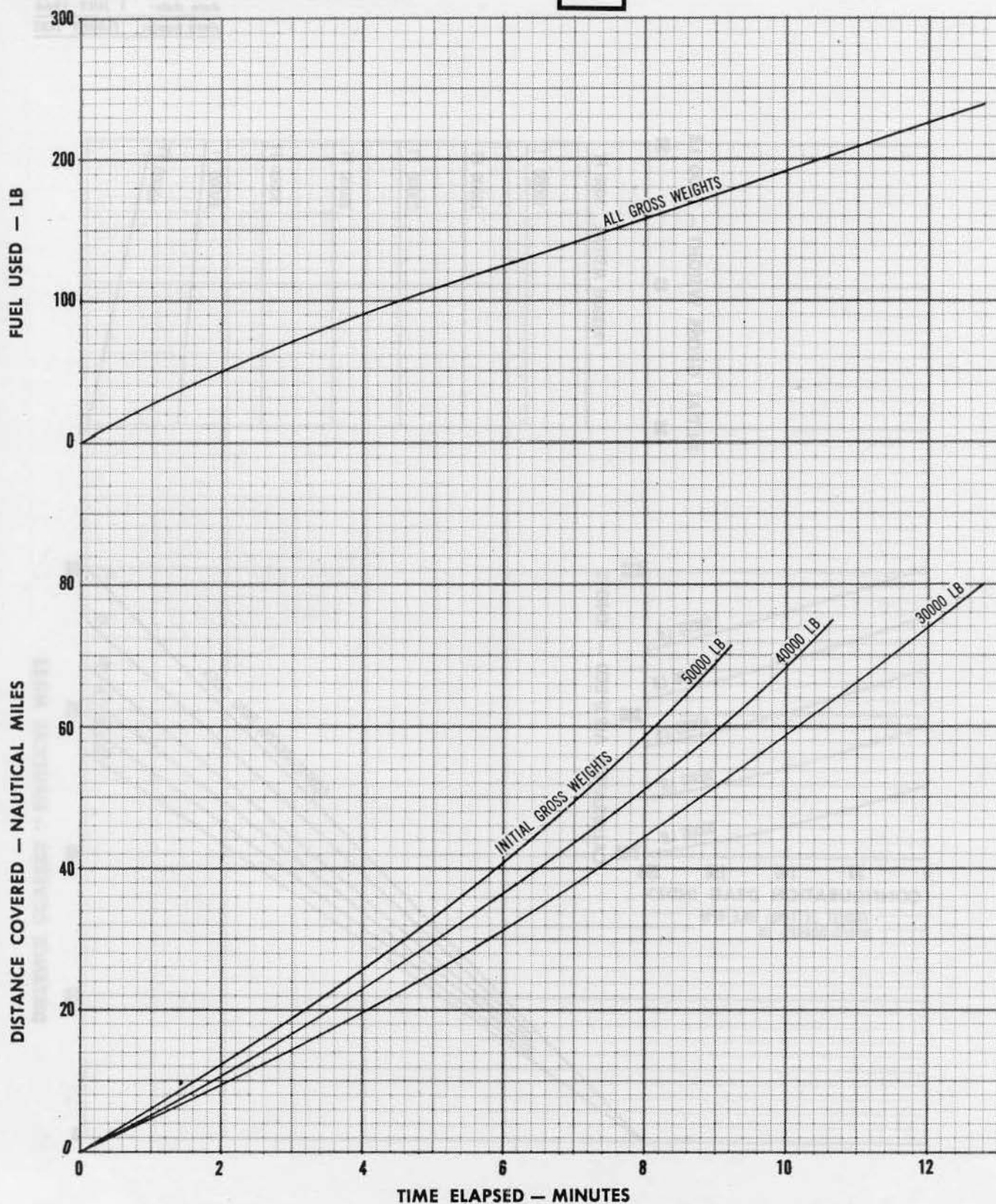
F**MAXIMUM RANGE DESCENT**

Figure B7-1 (Sheet 2 of 2)

COMBAT DESCENT

F

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4

fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

SPEED SCHEDULE: 0.9 MACH NO.
 OR 400 KCAS, WHICHEVER IS LESS.
 THRUST SETTING: IDLE RPM
 SPEED BRAKES: IN

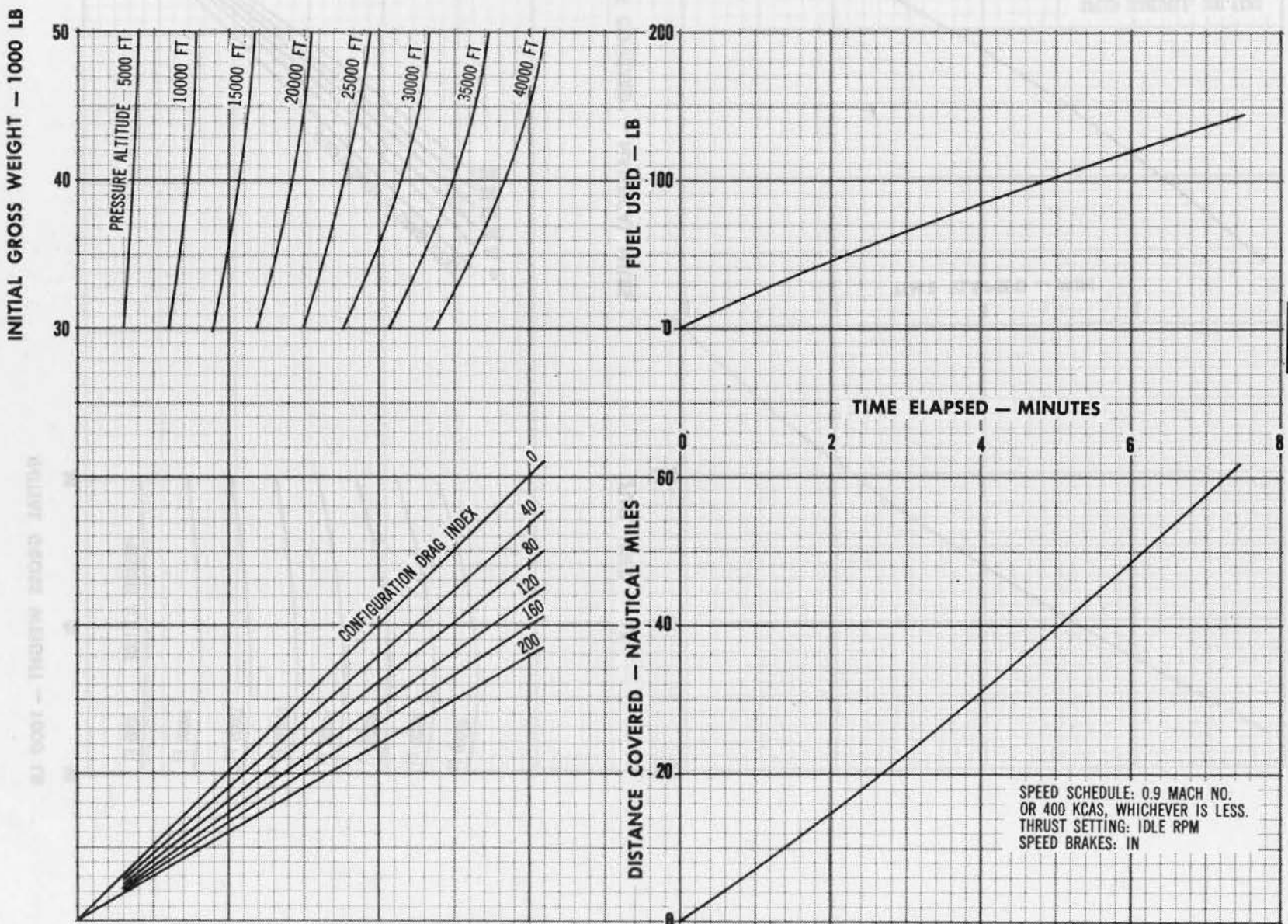


Figure B7-2

model:	F-105F	fuel density:	6.5 LB/GAL
engine:	J75-P-19W	data date:	1 JULY 1964
fuel grade:	JP-4	data basis:	FLIGHT TEST

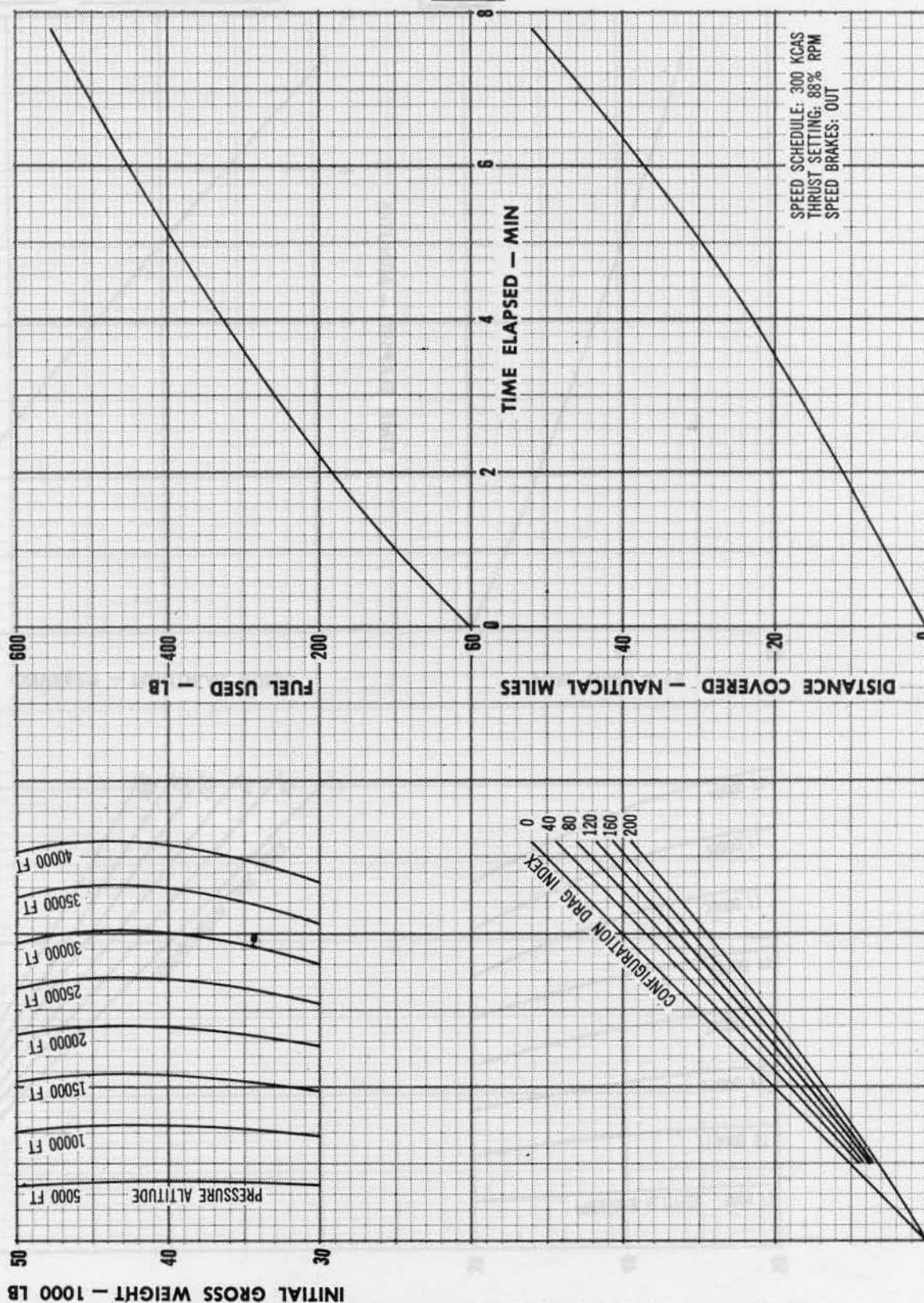
F**PENETRATION DESCENT**

Figure B7-3

PART 8 LANDING

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Runway Conditions	B8-1
Crosswind Landing Chart	B8-1, B8-9

LANDING DISTANCE

Separate landing ground roll and total distance to clear a 50-foot obstacle charts are shown for landings with and without drag chute deployment. These data are computed for flaps and gear down, speed brakes open. Effects on landing distances of ambient temperature, pressure altitude, aircraft gross weight, runway wind component, runway gradient and runway condition reading are shown on the ground roll charts. Incremental drag for externally loaded configurations has been accounted for at various aircraft gross weights. The effect of braking on a dry runway is shown separately, and total distance over 50 feet is read against ground roll and braking effectiveness. Landing speeds at final approach, 50-foot obstacle and touchdown are presented as a function of gross weight. The use of these charts is illustrated below by a sample problem.

RUNWAY CONDITIONS

In order that pilots might be aware of slippery conditions at terminal airfields, a system of reporting has been established. First, a teletype sequence will report conditions as a series of letters to indicate the runway surface condition. The number portion of this sequence is the Runway Condition Reading (RCR). Second, Air Traffic Control will report the information concerning Runway Surface Condition and Runway Condition Reading for the benefit of aircraft anticipating a landing. Following is an explanation of the terms used:

RCR	—	Runway Condition Reading
P	—	Patchy
WR	—	Wet Runway
SLR	—	Slush on Runway

LSR	—	Loose Snow on Runway
PSR	—	Packed Snow on Runway
IR	—	Ice on Runway

CROSSWIND LANDING CHART

The crosswind landing chart defines the conditions, in terms of wind direction and velocity and aircraft gross weight, under which it is possible to correct drift by holding the upwind wing down, through touchdown, thereby maintaining an uncrabbed approach. Increased touchdown speeds above normal, shown versus crosswind component and landing weight, are required to compensate for the loss in lift due to spoiler deflection. For very high crosswinds, indicated on the chart by the lightly shaded area, a combination of crab and upwind wing low approach is required. If the crosswind component is greater than 40 knots, the maximum sideslip angle available is not sufficient to avoid drift at touchdown, and landing under these conditions is not recommended. An example to illustrate its use is given on the crosswind chart.

Sample Problem

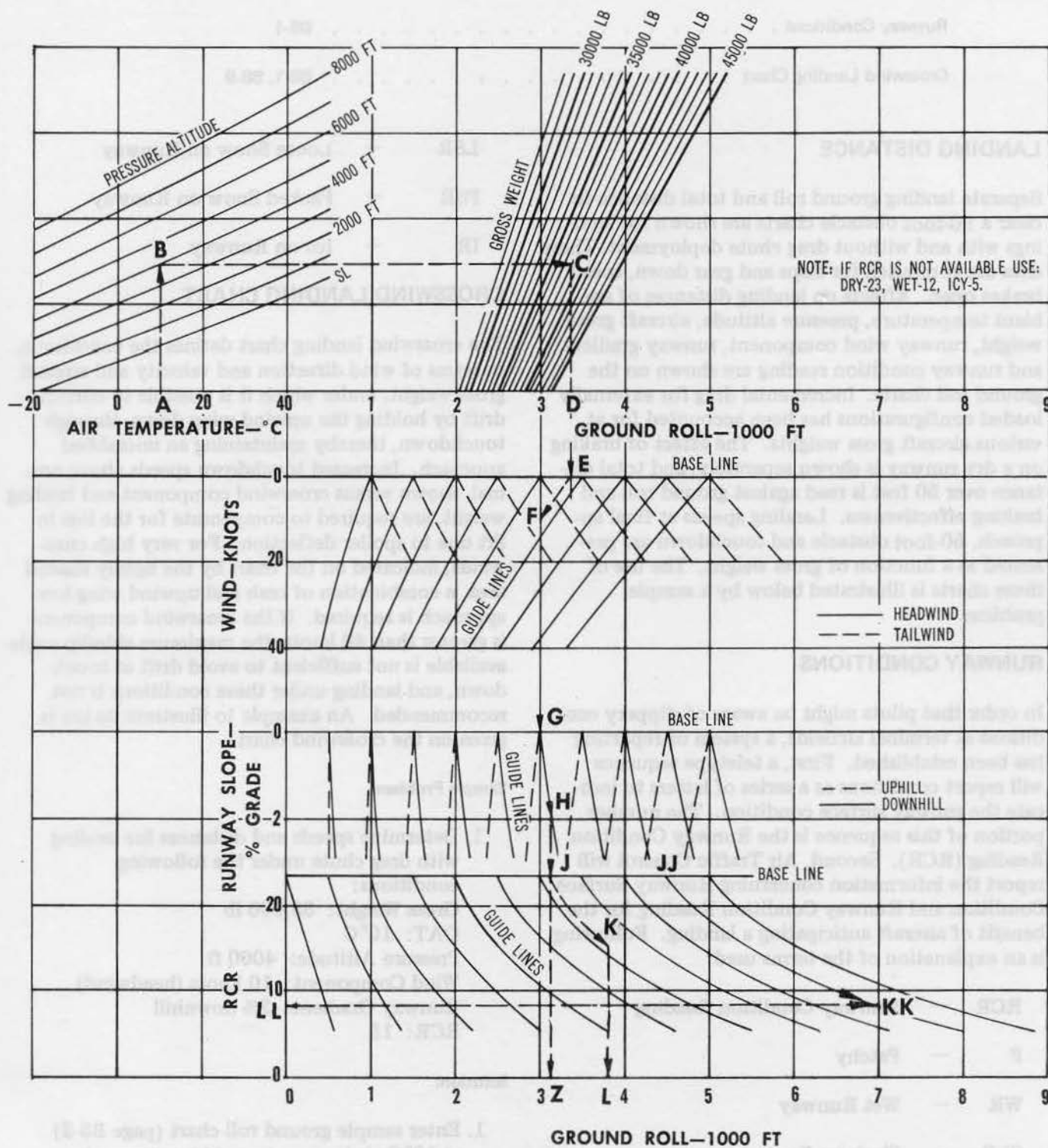
- Determine speeds and distances for landing with drag chute under the following conditions:
 Gross Weight: 38,000 lb
 OAT: 10°C
 Pressure Altitude: 4000 ft
 Wind Component: 10 knots (headwind)
 Runway Gradient: 2% downhill
 RCR: 15

Solution:

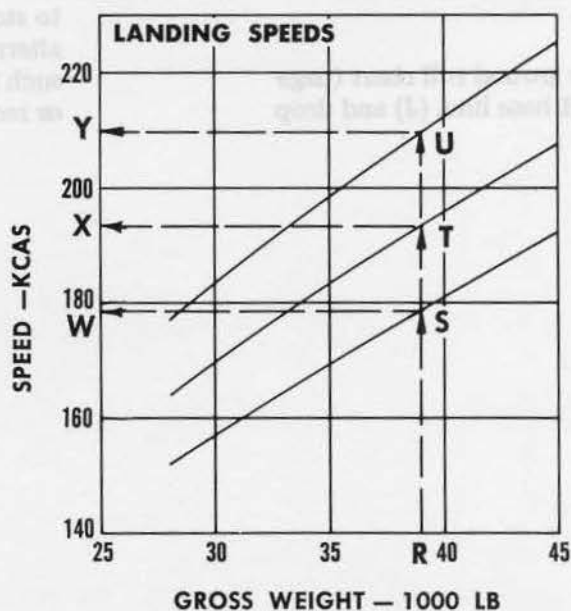
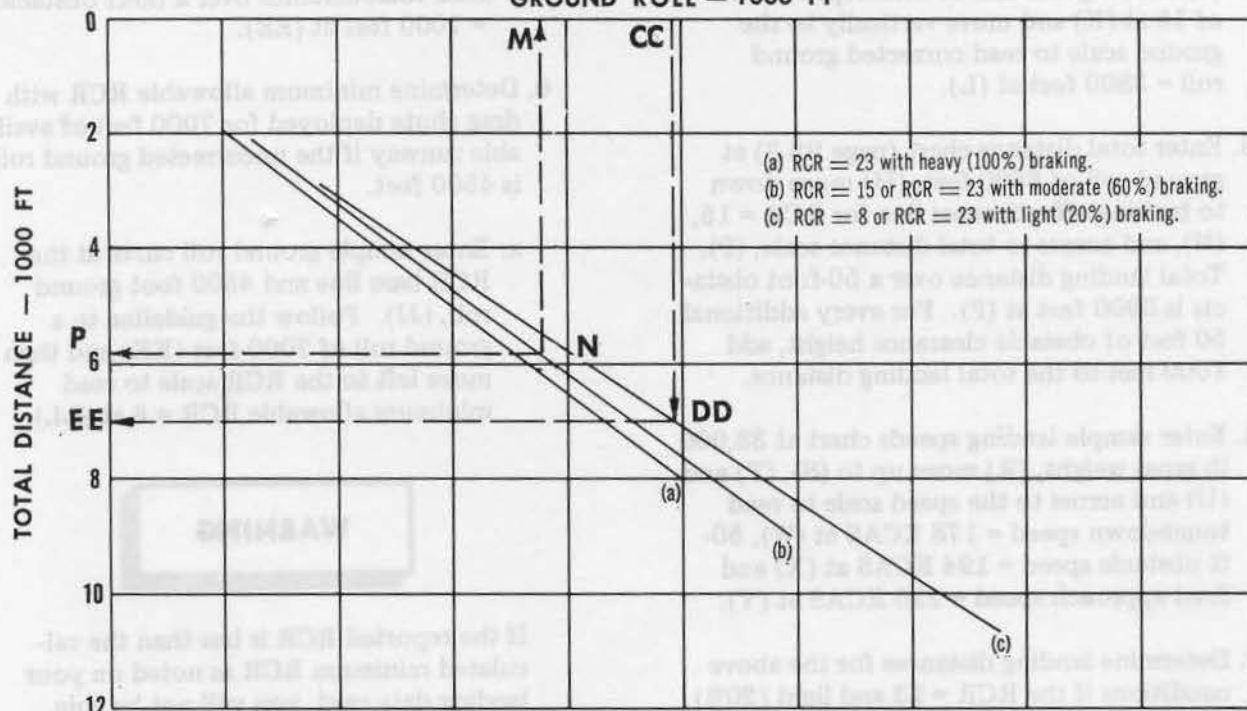
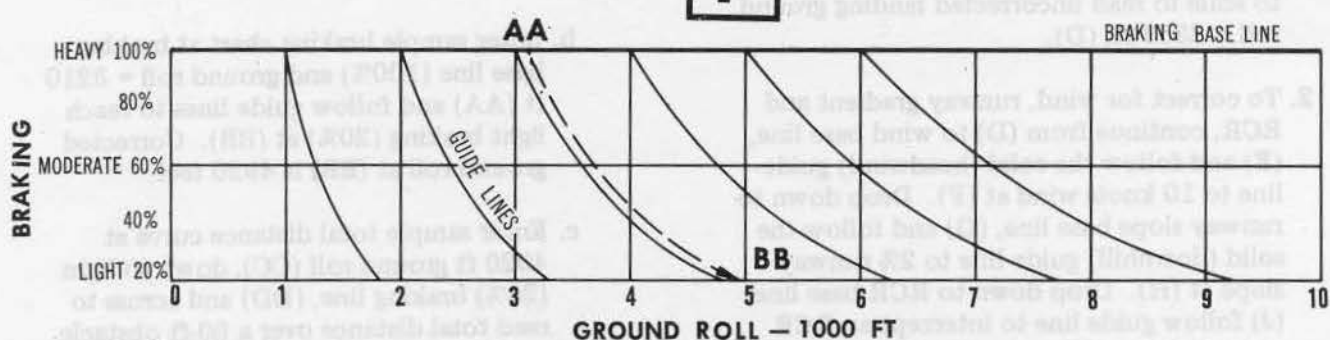
- Enter sample ground roll chart (page B8-2) at 10°C air temperature, (A), move up to

GROUND ROLL LANDING DISTANCE WITH DRAG CHUTE

F



BRAKING



B8-3

4000 ft pressure altitude line, (B) across to 38,000 lbs gross weight line, (C) and down to scale to read uncorrected landing ground roll = 3350 ft, (D).

2. To correct for wind, runway gradient and RCR, continue from (D) to wind base line, (E) and follow the solid (headwind) guide-line to 10 knots wind at (F). Drop down to runway slope base line, (G) and follow the solid (downhill) guide line to 2% runway slope at (H). Drop down to RCR base line, (J) follow guide line to intercept an RCR of 15 at (K) and move vertically to the ground scale to read corrected ground roll = 3800 feet at (L).
3. Enter total distance chart (page B8-3) at ground roll of 3800 feet, (M) move down to braking effectiveness line for RCR = 15, (N), and across to total distance scale, (P). Total landing distance over a 50-foot obstacle is 5900 feet at (P). For every additional 50 feet of obstacle clearance height, add 1000 feet to the total landing distance.
4. Enter sample landing speeds chart at 38,000 lb gross weight, (R) move up to (S), (T) and (U) and across to the speed scale to read touchdown speed = 178 KCAS at (W), 50-ft obstacle speed = 194 KCAS at (X) and final approach speed = 210 KCAS at (Y).
5. Determine landing distances for the above conditions if the RCR = 23 and light (20%) braking is used.
 - a. Enter sample ground roll chart (page B8-2) at RCR base line, (J) and drop

down to read ground roll = 3120 ft at (Z).

- b. Enter sample braking chart at braking base line (100%) and ground roll = 3210 ft (AA) and follow guide lines to reach light braking (20%) at (BB). Corrected ground roll at (BB) is 4920 feet.
 - c. Enter sample total distance curve at 4920 ft ground roll (CC), down to light (20%) braking line, (DD) and across to read total distance over a 50-ft obstacle = 7000 feet at (EE).
6. Determine minimum allowable RCR with drag chute deployed for 7000 feet of available runway if the uncorrected ground roll is 4500 feet.
 - a. Enter sample ground roll curve at the RCR base line and 4500 foot ground roll, (JJ). Follow the guideline to a ground roll of 7000 feet (KK) and then move left to the RCR scale to read minimum allowable RCR = 8 at (LL).

WARNING

If the reported RCR is less than the calculated minimum RCR as noted on your landing data card, you will not be able to stop on the runway. Divert to an alternate or take action as necessary; such as prepare for barrier engagement or reduce weight.

GROUND ROLL LANDING DISTANCE
HEAVY BRAKING
WITH DRAG CHUTE
SPEED BRAKES OPEN
IDLE THRUST
HARD SURFACE RUNWAY
LE FLAPS — 100%, TE FLAPS — 100%

F

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

NOTE: IF RCR NOT AVAILABLE, USE:
 DRY-23, WET-12, ICY-5

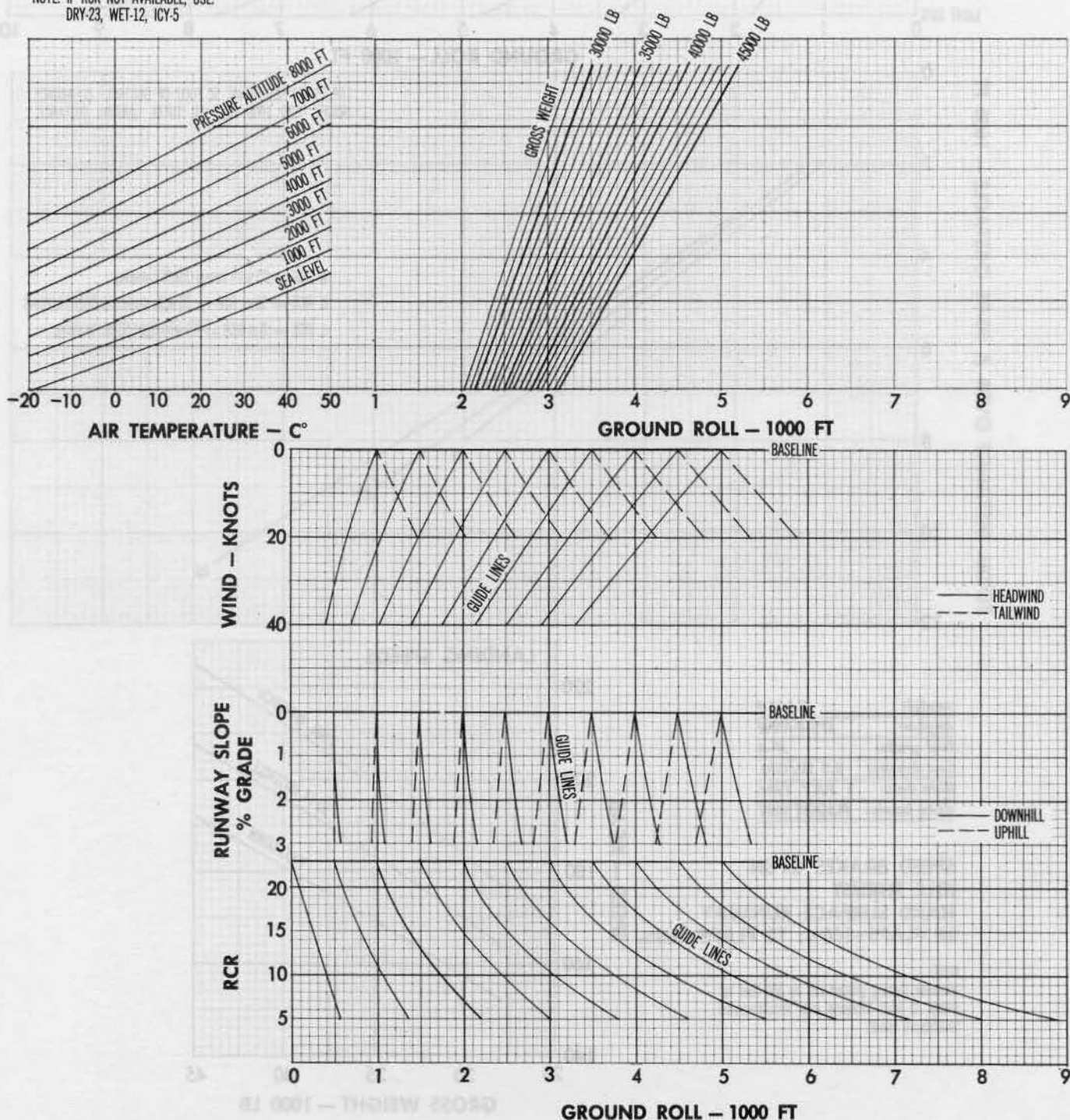
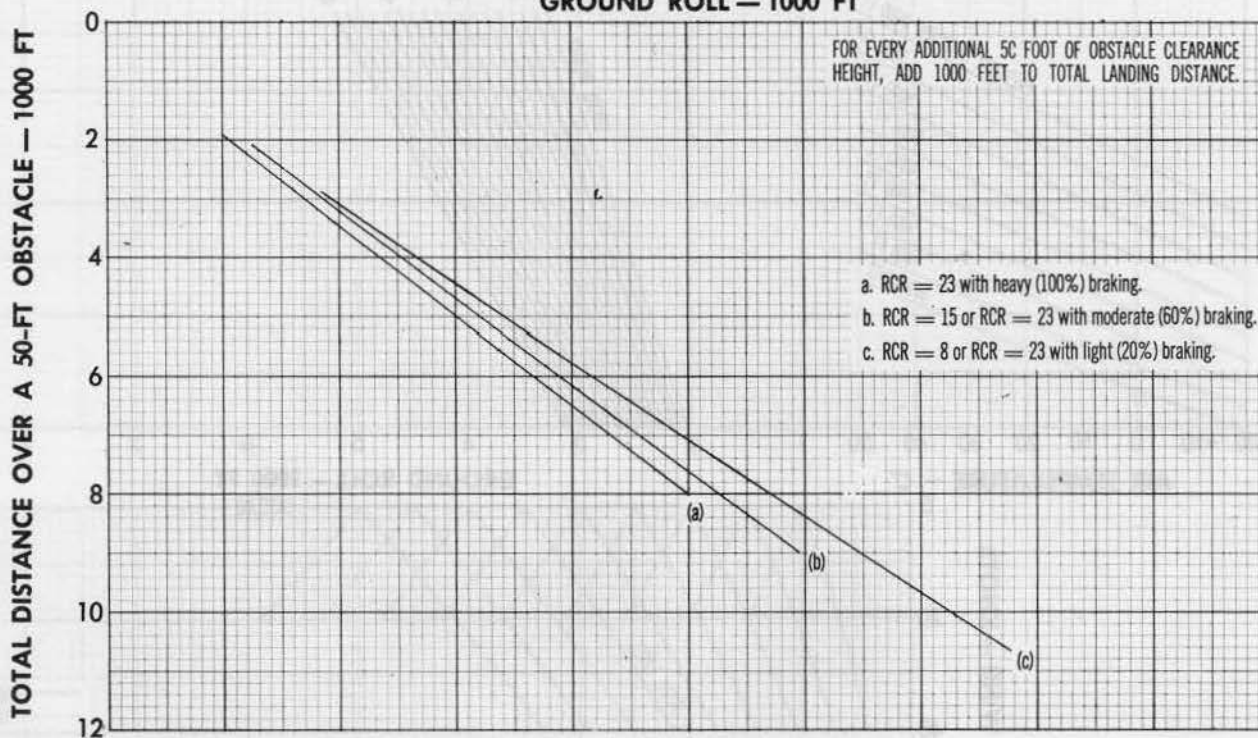
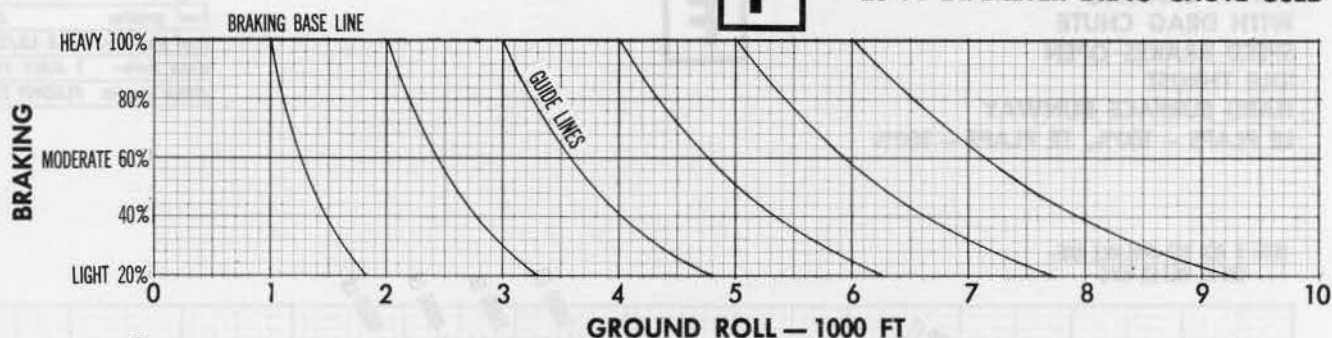


Figure B8-1 (Sheet 1 of 2)

F**GROUND ROLL LANDING DISTANCE
20 FT DIAMETER DRAG CHUTE USED**

model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

**SPEED BRAKES OPEN
IDLE THRUST
HARD SURFACE RUNWAY
LE FLAPS-100%; TE FLAPS-100%**

NOTE:
Increase landing ground roll by 350 feet for every 10 knot increase over recommended touchdown speed.

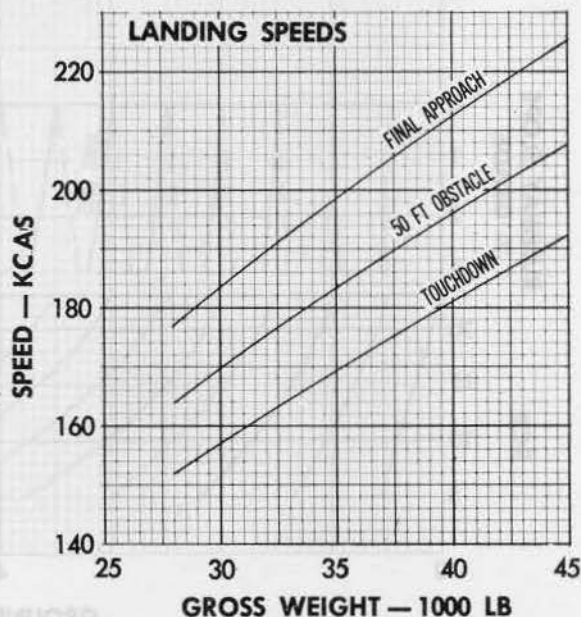


Figure B8-1 (Sheet 2 of 2)

GROUND ROLL LANDING DISTANCE

NO DRAG CHUTE

HEAVY BRAKING

SPEED BRAKES OPEN

IDLE THRUST

HARD SURFACE RUNWAY

LE FLAPS—100%; TE FLAPS—100%

F

model:	F-105F
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 JULY 1964
data basis:	FLIGHT TEST

NOTE: IF RCR NOT AVAILABLE,
USE DRY-23, WET-12, ICY-5

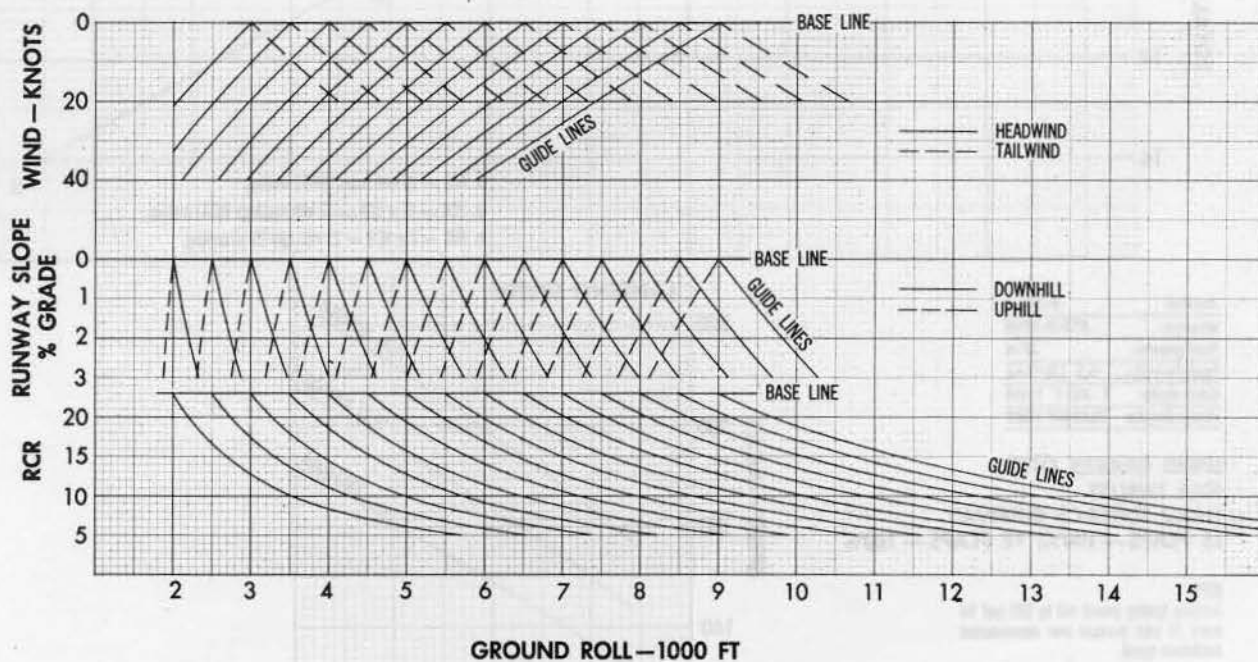
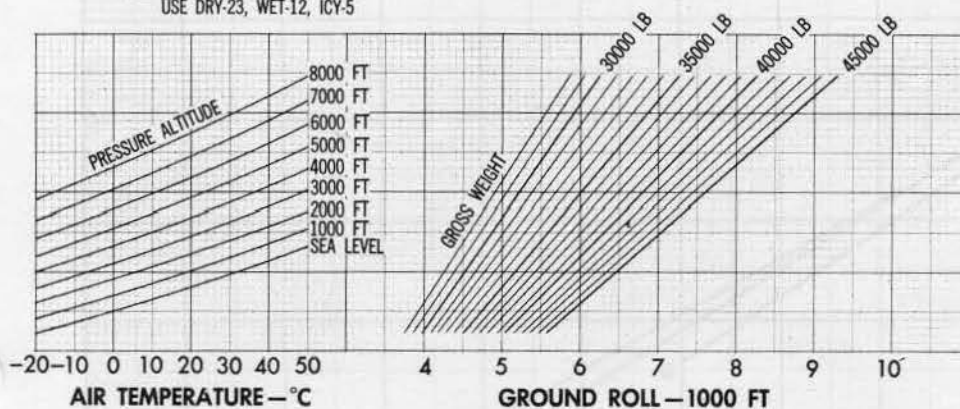
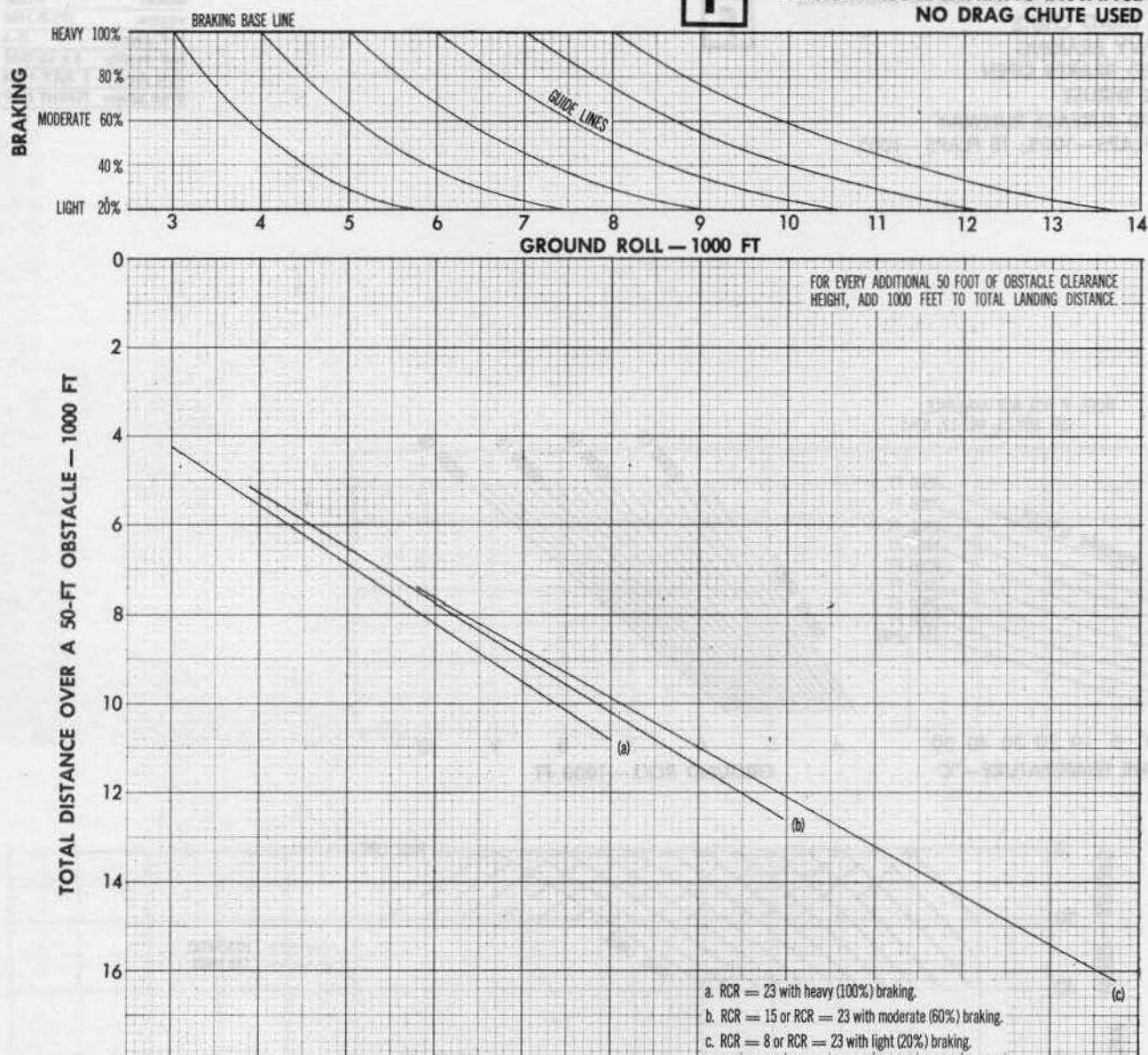


Figure B8-2 (Sheet 1 of 2)

F**GROUND ROLL LANDING DISTANCE
NO DRAG CHUTE USED**

model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

**SPEED BRAKES OPEN
IDLE THRUST
HARD SURFACE RUNWAY
LE FLAPS — 100%; TE FLAPS — 100%**

NOTE:
Increase landing ground roll by 600 feet for every 10 knot increase over recommended touchdown speed.

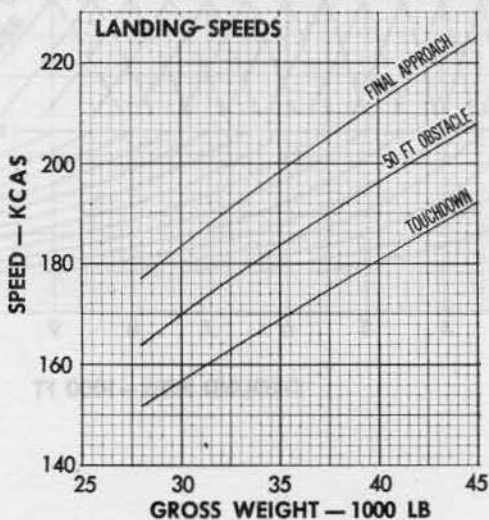


Figure B8-2 (Sheet 2 of 2)

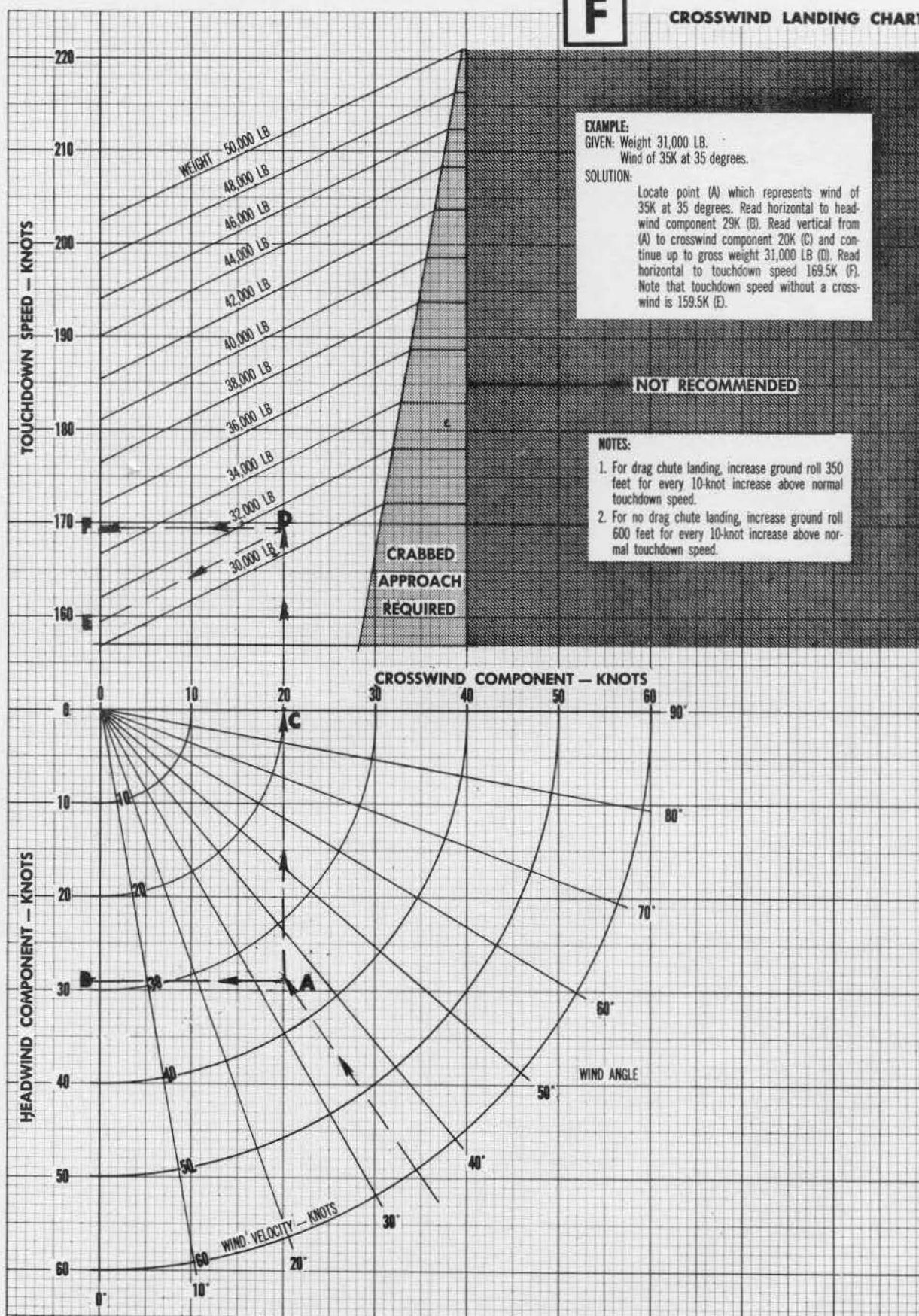
F**CROSSWIND LANDING CHART**

Figure B8-3

PART 9 COMBAT PERFORMANCE

TABLE OF CONTENTS

Combat Allowance Chart	B9-1
Maximum Level Flight Mach Number — Maximum Thrust	B9-5
Maximum Level Flight Mach Number — Military Thrust	B9-7

COMBAT ALLOWANCE

EXAMPLE 1

Conditions: Configuration: Clean + (2) 450 gal. tanks (inboard)

Initial Gross Weight: 44000 lb
 Combat Altitude: 30000 ft
 Combat Thrust Setting: Military
 Combat Fuel: 2000 lb
 Ambient Temperature: 5°C warmer than
 standard

Find: Military High Speed and time available for combat.

Solution:

1. Determine the Configuration Drag Index by adding the store drag numbers obtained from figure B1-5.

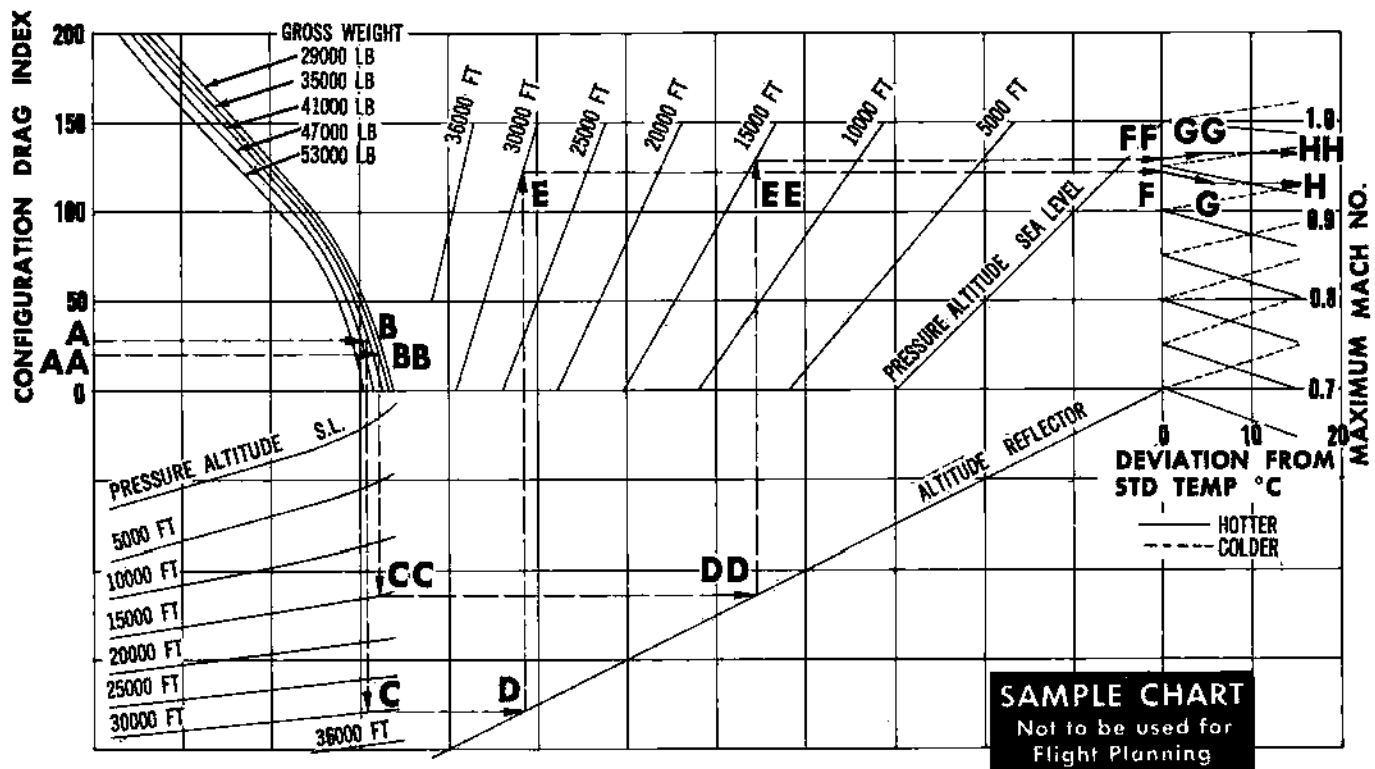
Store	Location	Store Drag NO.
(1) 450 gal tank	Left inb'd	14
(1) 450 gal tank	Right inb'd	<u>14</u>
Configuration Drag Index =		28

2. Determine Average Gross Weight

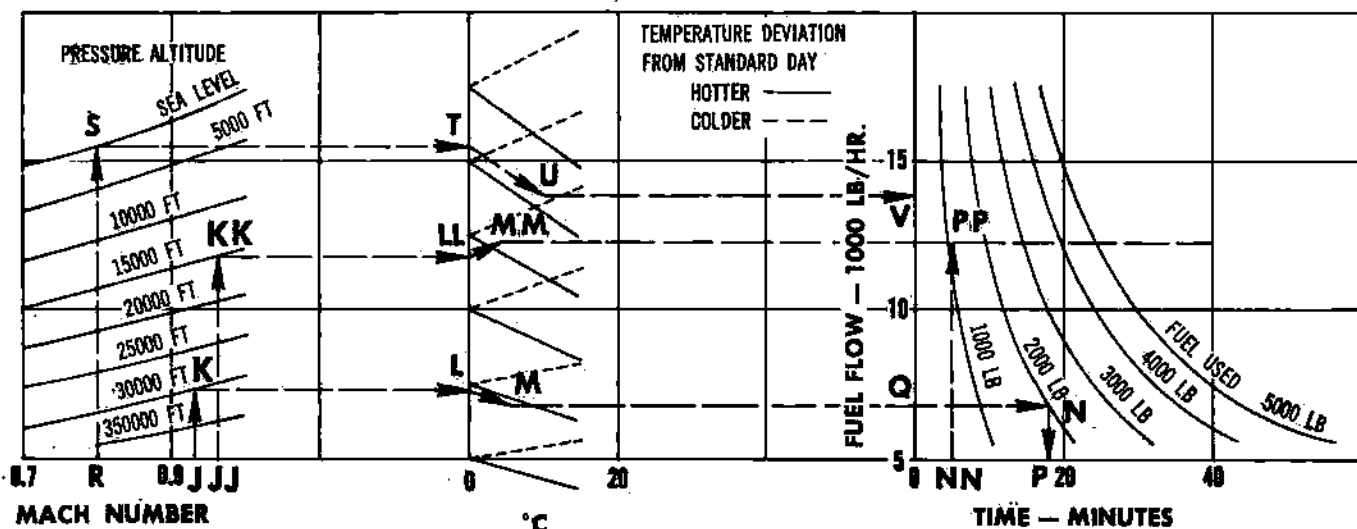
Initial Gross Weight = 44000 lb
 Fuel used in Combat = 2000 lb
 Final Gross Weight = 42000 lb
 Average Gross Weight = $\frac{44000 + 42000}{2} = 43000$ lb

- 3. Enter Sample Maximum Level Flight Mach Number Chart — Military Thrust, page (B9-2) at Configuration Drag Index = 28, (A). Move to the right and intercept average gross weight = 43000 lb, (B) and project down to combat pressure altitude = 30000 ft, (C).**

**MAXIMUM LEVEL FLIGHT MACH NUMBER
MILITARY THRUST**



**COMBAT ALLOWANCE CHART
MILITARY THRUST**



4. From (C) move to the right to intercept altitude reflector line at (D), then project upward to intercept combat pressure altitude = 30000 ft, (E). Move to the right stopping at the Zero Deviation from Standard Day, (F).
5. From (F) follow the solid (hotter) guide lines to 5°C deviation from Standard Day, (G). Move to the right and read maximum level flight Mach number = 0.93, (H).
6. Enter Sample Combat Allowance Chart — Military Thrust, page (B9-2) at Combat Mach number = 0.93, (J). Move up to combat pressure altitude = 30000 ft, (K) and move to the right to Zero Deviation from Standard Day, (L).
7. From (L) follow the solid (hotter) guide lines to 5°C deviation, (M). Then move across to the 2000 lb fuel used line, (N). Drop to the time scale and read time available = 18 min, (P).

If fuel flow is required, read fuel flow scale at (Q) = 6850 lb/hr.

EXAMPLE II

Conditions: Configuration: Clean + (2) AGM-12B Missiles (outboard)

Initial Gross Weight: 38000 lb
 Combat Altitude: 15000 ft
 Combat Thrust Setting: Military
 Combat Time: 5 minutes
 Ambient Temperature: 5°C colder than standard

Find: Military Thrust High Speed and fuel required for combat.

Solution:

1. Determine the Configuration Drag Index by adding the store drag numbers obtained from figure B1-5.

Store	Location	Store Drag NO.
(1) AGM-12B	Left outb'd	10
(1) AGM-12B	Right outb'd	10
Configuration Drag Index =		20

2. Estimate Average Gross Weight

$$\begin{aligned} \text{Initial Gross Weight} &= 36000 \text{ lb} \\ \text{Estimated Combat Fuel} &= 1000 \text{ lb} \\ \text{Estimated Final Gross Weight} &= 35000 \text{ lb} \\ \text{Estimated Average Gross Weight} &= \frac{36000 + 35000}{2} = 35500 \text{ lb} \end{aligned}$$

3. Enter Sample Maximum Level Flight Mach Chart — Military Thrust, page (B9-2) at Configuration Drag Index = 20, (AA). Move to the right and intercept estimated average gross weight, 35500 lb, (BB) and project down to Combat pressure altitude = 15000 ft, (CC).
4. From (CC) move to the right to intercept altitude reflector line at (DD), then project upward to intercept combat pressure altitude = 15000 ft, (EE). Move to the right stopping at the Zero Deviation from Standard Day, (FF).
5. From (FF) follow the dashed (colder) guide lines to 5°C deviation from Standard Day, (GG). Move to the right and read maximum level flight Mach Number = 0.962, (HH).
6. Enter Sample Combat Allowance Chart — Military Thrust, page (B9-2), at Combat Mach number = 0.962, (JJ). Move up to Combat pressure altitude = 15000 ft, (KK). Move to the right to Zero Deviation from Standard Day at (LL).
7. From (LL) follow the dashed (colder) guide lines to 5°C deviation, (MM). Construct a horizontal line from (MM).
8. Enter the time scale at 5 minutes, (NN). Move up to intersect line at (PP) and read fuel required for combat = 1020 lb.
9. Revising the Estimated Average Gross Weight and reworking the computation will result in the same readings.

EXAMPLE III

Conditions:

Combat Altitude: Sea Level
 Combat Speed: 0.8 Mach
 Combat Thrust Setting: Military
 Ambient Temperature: 10°C warmer than standard

Find: Fuel Flow and fuel required for 5 minutes of combat.

Note

This example assumes that level flight high speed has already been determined for the gross weight and configuration conditions and that 0.8 Mach number does not exceed Military Thrust capability.

Solution:

1. Enter sample Combat Allowance Chart — Military Thrust, page (B9-2) at lower left hand corner at Mach number = 0.8, (R).
2. Move up to the Sea Level line, (S).
3. Move to the left to Zero deviation from Standard Day at (T).
4. Follow the solid (hotter) guide lines to 10°C deviation, (U).
5. Move horizontally to the fuel flow scale and read fuel flow = 13800 lb/hr, (V).
6. Fuel required for 5 minutes = $\text{lb/hr} \times 5 \text{ min} / 60 \text{ min} = 13800 \times 1/12 = 1150 \text{ lb}$ OR continue line UV until it intersects the five minute vertical and read 1150 lb at the intersection.

MAXIMUM THRUST COMBAT ALLOWANCE **MAXIMUM LEVEL FLIGHT MACH NUMBER**

F

model: F-105F
 engine: J75-P-19W
 fuel grade: JP-4
 fuel density: 6.5 LB/GAL
 data date: 1 JULY 1964
 data basis: FLIGHT TEST

Maximum level flight Mach Numbers will be significantly conservative if a drag number of 20 is used for clean aircraft (947) C/W.

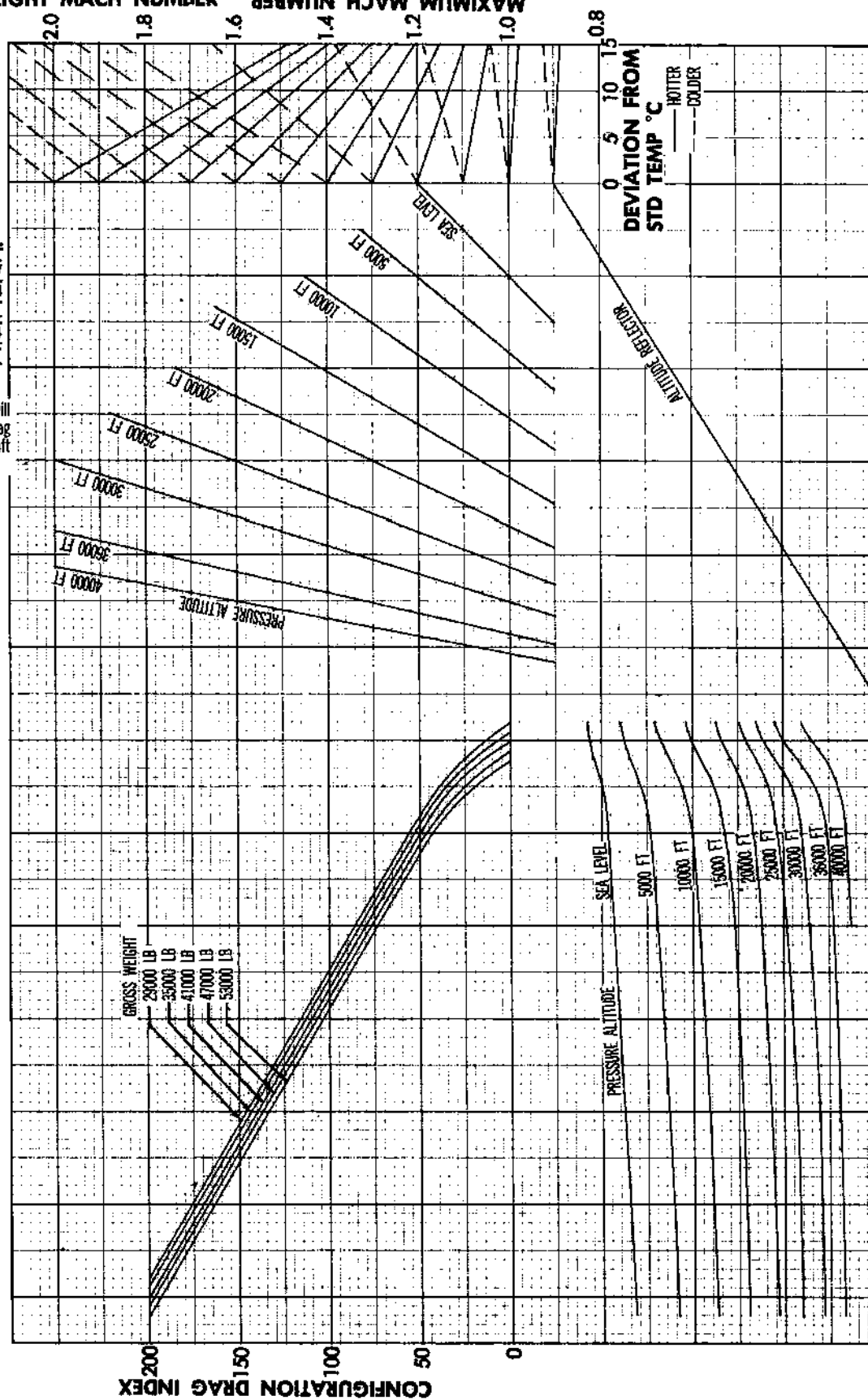


Figure B9-1 (Sheet 1 of 2)

F**COMBAT ALLOWANCE CHART**

Maximum level flight Mach Numbers will be significantly conservative if a drag number of 20 is used for clean aircraft [947] C/W.

Model:	F-105F
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 JULY 1964
data basis:	FLIGHT TEST

NOTE:
Continuous operation with Maximum Thrust is limited to 15 minutes.

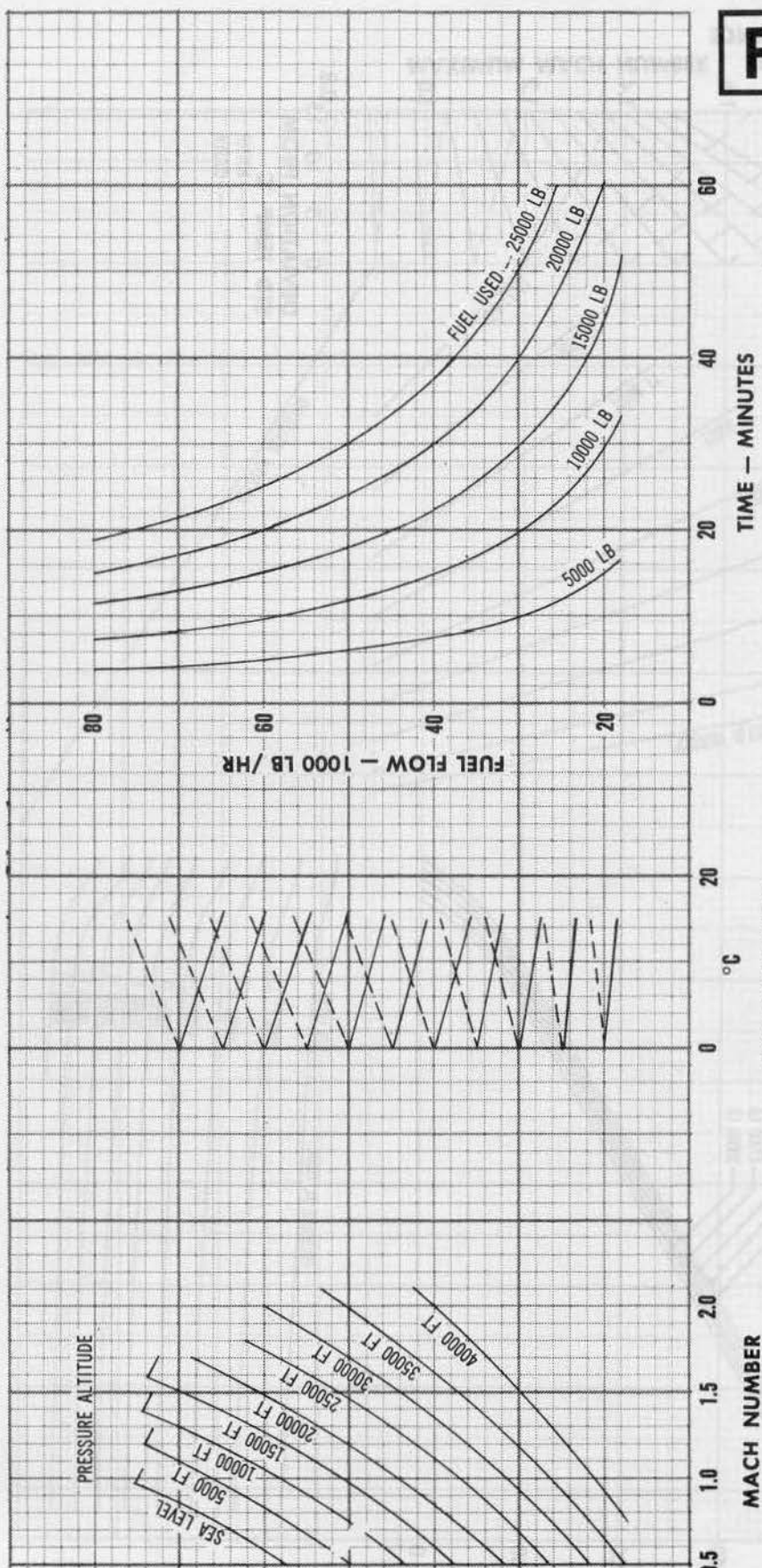


Figure B9-1 (Sheet 2 of 2)

**MILITARY THRUST
COMBAT ALLOWANCE
MAXIMUM LEVEL FLIGHT
MACH NUMBER**

F

model: F-105F
engine: J75-P-19W
fuel grade: JP-4
fuel density: 6.5 LB/GAL
data date: 1 JULY 1964
data basis: FLIGHT TEST

Maximum level flight Mach Numbers will be significantly conservative if a drag number of 20 is used for clean aircraft [947] C/W.

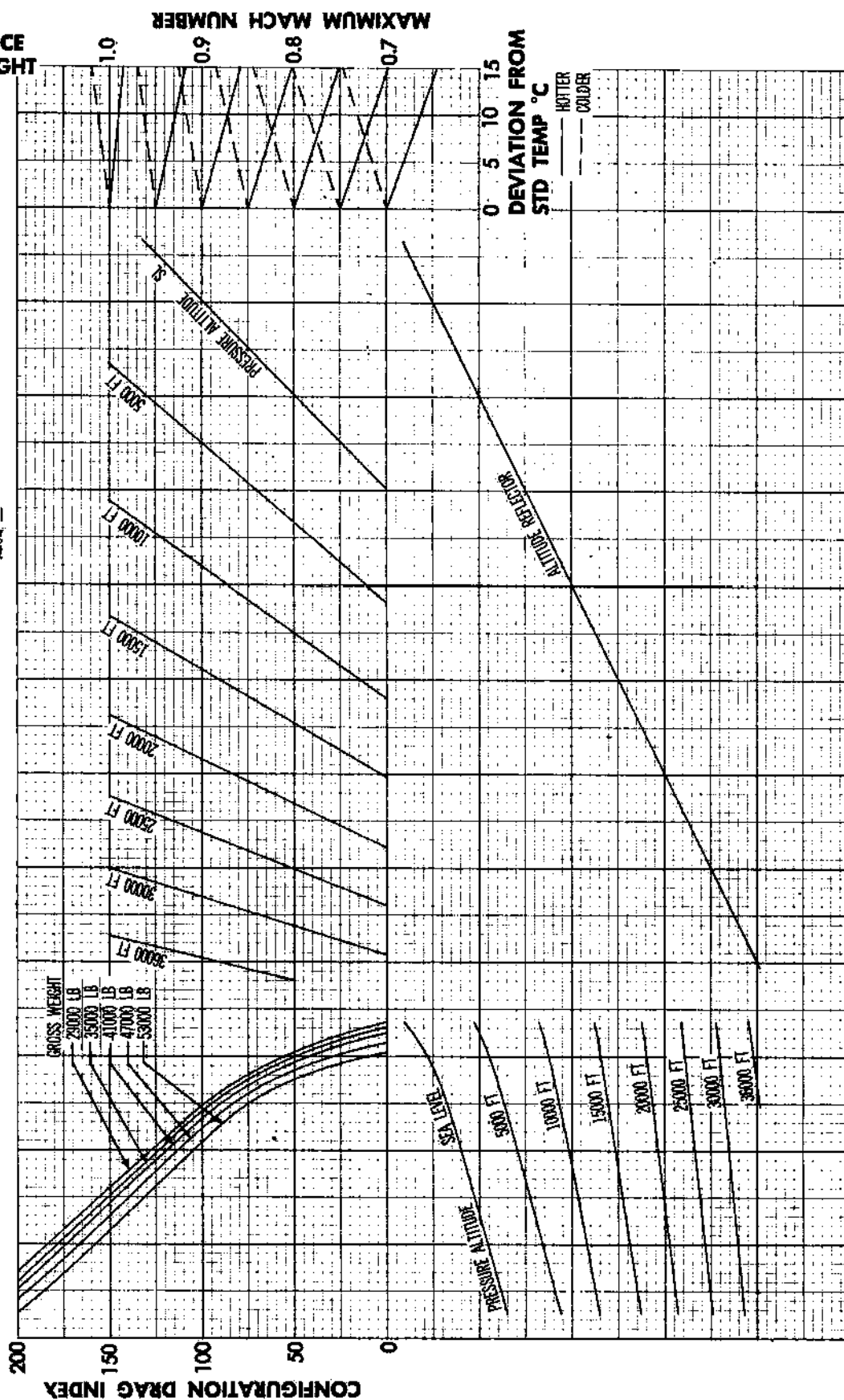
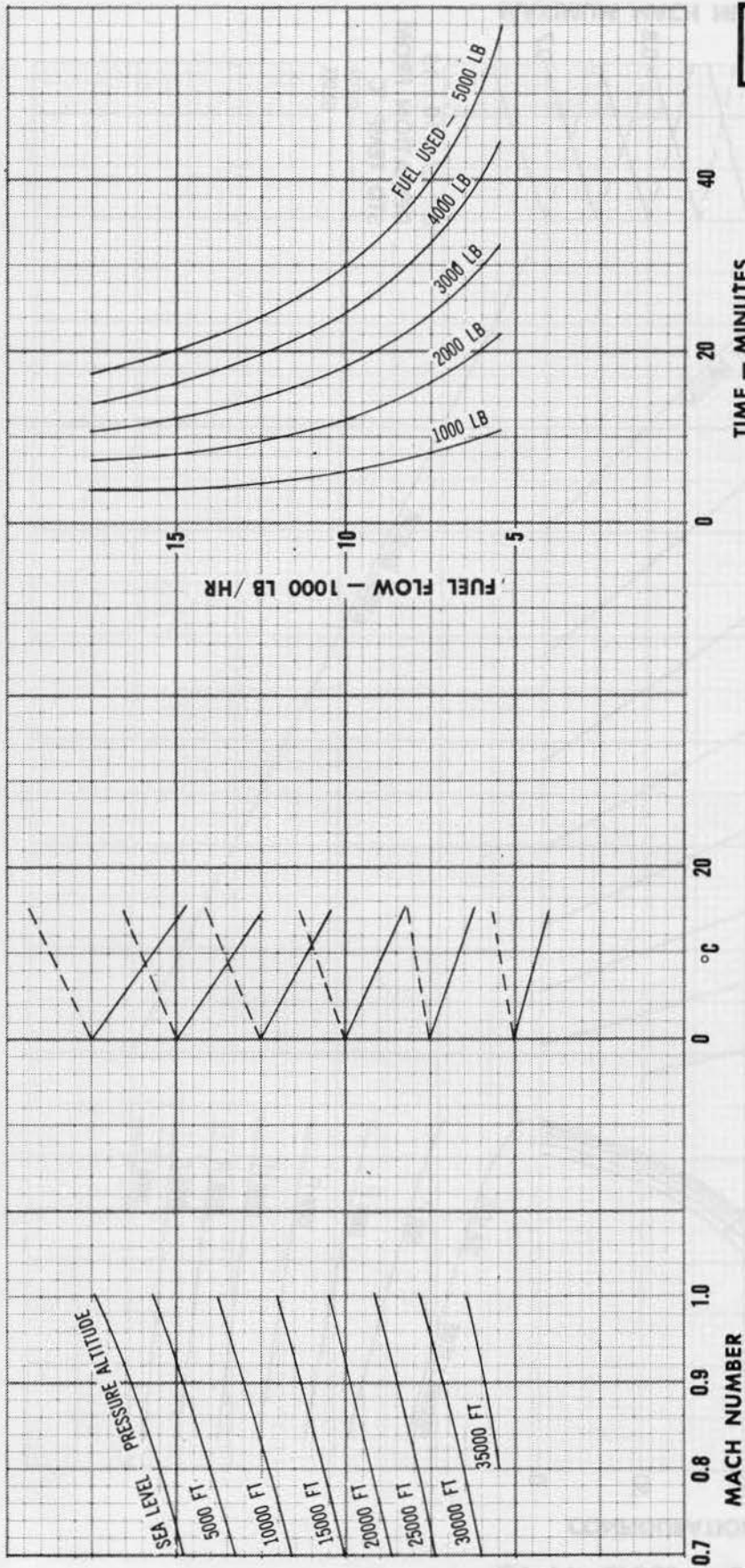


Figure B9-2 (Sheet 1 of 2)



COMBAT ALLOWANCE CHART

Maximum level flight Mach Numbers will be significantly conservative if a drag number of 20 is used for clean aircraft [947] C/W.

NOTE: Continuous operation with Military Thrust is limited to 30 minutes.

Model:	F-105F
engine:	J75-P-19W
fuel grade:	JP-4
fuel density:	6.5 LB/GAL
data date:	1 JULY 1964
data basis:	FLIGHT TEST

Figure B9-2 (Sheet 2 of 2)

PART 10 MISSION PLANNING

INTRODUCTION.

The scope of mission planning can be enhanced through the drag count concept, since all combat missions can be computed for any possible combination of store loadings. Therefore, a thorough knowledge of the methods of using these charts can be an important tool in flight operations. By actually working through a precise combat mission, a more thorough understanding of the applicable charts will be attained. Figures B10-1 through B10-4 show the use of the performance charts for a number of specific missions.

RULES OF THUMB.

As an additional guide to Mission Planning, the following rules of thumb for range variation due to fuel loading, cruise altitude and low altitude dash are offered. It should be noted that these are very rough estimates to enable the mission planner to determine the approximate configuration and flight plan required to complete a given mission. Large variations from these estimates occur for differences in Drag, Aircraft Weight, Combat Allowances, High Speed Runs, Altitudes flown, Weather Conditions, etc. Once the rules of thumb have been applied to give an order of magnitude, a precise mission calculation must be performed to determine the actual radius or range values. The use of these approximations and some of the variation from actual mission computations are illustrated in the precise mission planning sections.

1. Approximate Radius of Action for Fuel.

Fuel Loading	General Profile		
	High Altitude NMi	Low Altitude NMi	Lo-Hi NMi
Normal Internal	220	110	155
Add for Bomb Bay Tank	130	65	90
Full Internal	350	175	245
* Add for Wing Tanks (2)	300	150	210
* Add for 650 Gal CL	200	100	140
*Dropped when empty			

2. Approximate Trade-Off of Low Altitude Cruise For High.

One and a half to two nautical miles of high altitude cruise range can be achieved for every nautical mile of low altitude cruise range.

EXAMPLE:

Problem: 425 NMi has been established for a Lo-Lo cruise radius of action for a particular configuration and profile. In order to attack a target 500 NMi from base and return, how many miles must be at high altitude? (Hi-Lo-Lo-Hi).

Estimate: One hundred nautical miles of low altitude cruise is equivalent to approximately 175 miles at high altitude. Therefore, reduce lo-lo portion by 100 NMi radius of action and substitute 175 NMi of hi-hi radius.

Total Radius of Action: $425 - 100 = 325$ Lo-Lo
 $+ 175$ Hi-Hi = 500 NMi Estimated R/A

3. Approximate Trade-Off of Low Altitude Cruise For Low Altitude Dash.

The trade-off of cruise for dash at low altitude depends large on configurations and speeds. However, the following is a broad generalization of the effect of substituting non-afterburning dash at low altitude for low altitude cruise: Allow 2/3 of a nautical mile in dash for every nautical mile in cruise.

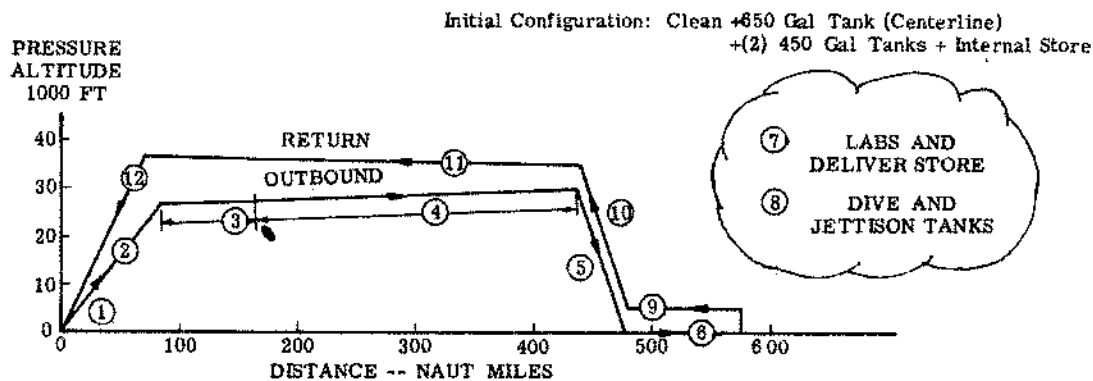
EXAMPLE:

Problem: What would the Hi-Lo-Lo-Hi radius of action shown above become if the low portions were flown at 0.9 Mach number at Sea Level?

Estimate: 325 Lo-Lo cruise $\times 2/3 = 217$ Lo-Lo dash at 0.9 M.

Total Radius of Action: 217 Lo-Lo at 0.9M
 $+ 175$ Hi-Hi = 392 NMi Estimated R/A

Hi-Lo-Lo-Hi Mission (Sample Problem 1)



Step	Operation	Config Drag Index	Leg Fuel Used	Sum Fuel Used	Fuel Re-remaining	Final Gross Weight	Alt. At End of Step	Leg Time	Sum Time	Leg Dist.	Sum Dist.
			LB.	LB.	LB.	LB.	FT.	MIN	HR:MIN	NMI	NMI
	Initial Configuration		0	0	17615	50680			0		0
1	Taxi, Take-Off and Accelerate to climb speed*		1500	1500	16115	48880	S. L.	1	0:01	-	0
2	Military Thrust Climb to Initial Cruise-Climb Alt.	42	1795	3295	14320	47085	26900	10	0:11	85	85
3	Cruise-Climb Jettison Centerline Tank	42	930	4225	13390	46155 45808	27300	9	0:20	78	163
4	Cruise-Climb	28	3060	7285	10330	42748	29100	32	0:52	272	435
5	Combat Descent to S. L.	28	105	7390	10225	42643	S. L.	5	0:57	40	475
6	Dash-In at 0.9 M at S. L.	28	2500	9890	7725	40143	S. L.	10	1:07	100	575
7	Labs Maneuver and Deliver Store	28	250	10140	7475	39893 37893	12000	1	1:08	-	-
8	Jettison Wing Tanks Dive (30°) to S. L.	0	80	10220	7395	37235 37155	S. L.	1	1:09	-	-
9	Dash-Out at 0.9 M at S. L.	0	2190	12410	5205	34965	S. L.	10	1:19	100	675
10	Military Thrust Climb to Initial Return CR-CL Alt	0	1140	13550	4065	33825	34400	7	1:26	58	733
11	Cruise-Climb	0	2615	16165	1450	31210	36300	40	2:06	346	1079
12	Maximum Range Descent to S. L.	0	215	16380	1235	30995	S. L.	11	2:17	71	1150

*Reduce Weight 300 Lb. for Water.

Figure B10-1

SAMPLE PROBLEM I: HI-LO-LO-HI MISSION PLAN**Mission Rules:**

A combat mission is to be flown at long range speeds and altitudes, carrying drop tanks and an internal store. Within 100 nautical miles of the target, a run-in is to be performed at tree top level at 0.9 Mach number, and the store delivered at the top of a LABS Maneuver. After a 30° dive from the recovery altitude, run back 100 nautical miles from target. The drop tanks are to be jettisoned when empty. Prepare a flight plan for a target 575 nautical miles from the air base.

Weather Conditions:

Standard Day, no wind.

Configuration: [947] N/C/W

Clean + 650 gallon tank (centerline) + (2) 450 gallon tanks (inboard) + internal store.

Weights: (figure B1-5).

Clean Aircraft without B/B/ tank. . . . 37,300 LB
(7540 LB fuel)

650 gal tank (centerline) 347 LB

(2) 450 gal tanks 658 LB

External fuel
(650 + 900 GAL = 4225 + 5850 LB) . 10,075 LB

Internal Store 2,000 LB

Water for Take-Off 300 LB

Take-Off Gross Weight 50,680 LB

Total fuel on board (7540 + 10,075) . 17,615 LB

Computation:**Step 1. Take-Off.**

Assume that 1500 pounds of fuel, one minute and 300 pounds of water are used for take-off and acceleration to climb speed.

Gross weight after take-off
(50,680 - 1500 - 300) 48,880 LB

Time Elapsed 1.0 MIN

Fuel Remaining (17,615 - 1500) 16,115 LB

Step 2. Military Thrust Climb to Cruise-Climb Altitude.

- A. From figure A1-5 determine the initial configuration drag index.

650 GAL tank (centerline) 14

(2) 450 GAL tanks (inboard) 28

Initial Configuration Drag Index 42

Note

Configuration Drag Index changes whenever external tanks, bombs and/or pylons are jettisoned.

- B. From figure B3-4 read

1. Fuel Used 1680 LB

2. Distance Covered 84 NMi

3. Time Elapsed 10 MIN

- C. 1. Final Gross Weight (48,880 - 1795) 47,085 LB

2. Fuel Remaining (16,115 - 1795). 14,320 LB

- D. To determine the level-off altitude at the end of climb, enter "Optimum Cruise Altitude" Chart, Figure B3-5, at a gross weight of 47,085 LB (step 2-C-1) and Configuration Drag Index 42 and read the initial cruise-climb altitude = 26,900 FT.

Step 3. Outboard Cruise (first leg).

- A. Use figure A4-3 for Cruise-Climb Performance.

1. Cruise with fuel remaining in centerline tank (4225 - 1500 - 1795) 930 LB

2. Compute Average Gross Weight
47,085 - (930 ÷ 2) 46,620 LB

3. From figure B3-5 "Optimum Cruise Altitude" read altitude at the average gross weight during cruise 27,000 FT

- 4. From figure B1-10, read Standard Day temperature at 27,000 ft pressure altitude -38.5° C
- 5. From figure B4-3 Mach number for cruise 0.875 M
- 6. Time to cruise 8.8 MIN
- 7. Cruise distance 78 NMi
- 8. Final Gross Weight (47,085 - 930) 46,155 LB
- 9. Fuel Remaining (14,320 - 930) ... 13,390 LB

B. Jettison Centerline Tank

- 1. Final Gross Weight (46,155 - 347) 44,008 LB
- 2. New Configuration Drag Index (from figure B1-5; (2) 450 GAL tanks 28

Step 4. Outboard Cruise (2nd leg)

A. Determine outboard cruise distance. Since the flight plan calls for a radius of action of 575 nautical miles and the outboard distance is a combination of climb, cruise, descent and dash 100 NMi at Sea Level, estimate the descent distance.

- 1. Estimate a weight at start of descent as:

Final Gross Weight after centerline tank is jettisoned 45,808 LB
- 2. Configuration Drag Index 28
- 3. From figure B3-5 "Optimum Cruise Altitude" read final cruise climb altitude 27,600 FT
- 4. From figure B7-2 distance to descend 40 NMi
- 5. Compute cruise distance remaining (575 - 85 - 78 - 40 - 100) 272 NMi

B. Use figure B4-3 for Cruise-climb performance.

- 1. Estimate fuel used to cruise 272 NMi 2000 LB

- 2. Compute estimated average gross weight $45,808 - (2000 \div 2)$ 44,808 LB
- 3. From figure B4-3 "Optimum Cruise Altitude" read altitude for the average gross weight during cruise ... 28,200 FT
- 4. From figure B1-10 read Standard Day Temperature at 28,200 FT pressure altitude -41° C
- 5. From figure B4-3 Fuel used to cruise 272 NMi ... 3060 LB

C. Since the estimated fuel does not equal the computed fuel

- 1. Re-estimate average gross weight: $45,808 - (3060 \div 2)$ 44,278 LB
- 2. Re-read average cruise altitude from figure B3-5 28,300 FT
- 3. Read Standard Day Temperature at 28,300 ft pressure altitude ... -41° C
- 4. From figure A4-3 Fuel used to cruise 272 NMi ... 3060 LB
- 5. Mach number for cruise 0.878 M
- 6. Time to cruise 31.6 MIN
- 7. Final Gross Weight (45,808 - 3060) 42,748 LB
- 8. Fuel Remaining (13,390 - 3060) . 10,330 LB
- 9. From figure B3-5 "Optimum Cruise Altitude", final cruise altitude 29,100 FT

Step 5. Combat Descent to Sea Level (0.9 Mach or 400 KCAS whichever is less)

A. From figure B7-2

- 1. Distance to descent 40 NMi
- 2. Fuel used in descent 105 LB
- 3. Time elapsed in descent 5 MIN

4. Final gross weight (42,748 - 105) 42,643 LB

5. Fuel remaining (10,330 - 105) 10,225 LB

- B. Since the combat descent distance of step 5 is the same as that estimated in step 4, the mission can be continued into the next step. However, if the descent distance of step 5 varied from the estimate of step 4, then the last leg of the cruise portion would be changed by the same increment.

Step 6. Run-In (100 Nautical Miles at 0.9 Mach number)

- A. Estimate the fuel used for 100 nautical mile run in

1. Estimate dash fuel (fuel remaining in wing tanks) 5850 - 3060 - 105) 2685 LB

2. Estimate Average Gross Weight:
42,643 - (2685 ÷ 2) 41,300 LB

3. Ambient Temperature at S.L.
(figure B1-10) 15°C

4. From figure B4-4 read true airspeed
at 0.9 Mach number at 15°C 595 KN

5. From figure B4-4 read fuel
flow 14,900 LB/HR

6. Compute time required to dash
100 NMi (Dist ÷ Speed = Time)
100 ÷ 595) = 0.168 HR

7. Compute fuel required (fuel flow x
time) 14,900 x 0.168 2500 LB

- B. Since the estimated fuel does not equal the computed fuel

1. Re-estimate average gross weight
42,643 - (2500 ÷ 2) 41,393 LB

2. Read fuel flow from
figure B4-4 14,900 LB/HR

3. Since time and fuel flow have not changed,
steps 6A6 and 7 do not have to be re-done

4. Time in minutes
(0.168 HR x 60 MIN/HR) 10 MIN

5. Final gross weight (42,643-2500) . . 40,143 LB

6. Fuel remaining (10,225 - 2500) . . . 7725 LB

Step 7. Labs Maneuver (Bomb Delivery)

Allow approximately 250 pounds of fuel and one minute, with recovery at 12,000 FT for this maneuver.

1. Final gross weight
(40,143 - 250 - 2000*) 37,893 LB

2. Fuel remaining (7725 - 250) 7495 LB

3. Time Elapsed 1 MIN

*Weight of store

Step 8. Perform a 30° Dive to Sea Level and Jettison the (2) 450 gallon tanks.

- A. Allow approximately 80 pounds of fuel and half a minute for this maneuver

1. Final Gross Weight
(37,893 - 658* - 80) 37,155 LB

2. Fuel remaining (7475 - 80) 7495 LB

3. Time Elapsed 1 MIN

*Weight of tanks

- B. From figure B1-5, new Configuration Drag Index for the clean Aircraft = 0

Step 9. Run-Out (100 Nautical Miles at 0.9 Mach number)

- A. Use figure B4-4 for Dash Performance

1. Estimate dash fuel 2500 LB

2. Estimate average gross weight:
37,155 - (2500 ÷ 2) 35,909 LB

3. Ambient temperature at S.L. 15°C

4. From figure B4-4 read true airspeed at
0.9 Mach at 15°C 595 Knots

5. From figure B4-4 read fuel
flow 13,050 LB/HR

6. Compute time required to dash 100
NMi (dist ÷ speed = time) (100 ÷ 595) 0.168 HR

7. Compute fuel required (fuel flow x
time) 13,050 x 168) 2190 LB

B. Since the estimated fuel does not equal the computed fuel,

1. Re-estimate average gross weight
 $37,155 - (2190 \div 2) \dots\dots\dots 36,060 \text{ LB}$
2. Read fuel flow $\dots\dots\dots 13,050 \text{ LB/HR}$
3. Since time and fuel flow have not changed, steps 9A6 and 7 do not have to be re-done
4. Time in minutes
 $(0.168 \text{ HR} \times 60 \text{ MIN/HR}) \dots\dots\dots 10 \text{ MIN}$
5. Final gross weight $(37,155 - 2190) \dots\dots\dots 34,965 \text{ LB}$
6. Fuel remaining $(7395 - 2190) \dots\dots\dots 5205 \text{ LB}$

Step 10. Military Thrust Climb to Return-Cruise-Climb Altitude

- A. From figure B3-4 read the climb performance
- | | |
|------------------------------------|---------|
| Fuel used $\dots\dots\dots$ | 1140 LB |
| Distance covered $\dots\dots\dots$ | 58 NMi |
| Time elapsed $\dots\dots\dots$ | 7 MIN |
1. Final Gross weight $(34,965 - 1140) \dots\dots\dots 33,825 \text{ LB}$
 2. Fuel remaining $(5205 - 1140) \dots\dots\dots 4065 \text{ LB}$

Step 11. Determine return Cruise Distance

- A. Since the return distance must equal 575 NMi including return dash, climb, cruise and descent, estimate a descent distance
1. Estimate a weight at start of descent as: $(\text{Weight at end of climb} + \text{empty weight}) \div 2$
 $(33,825 + 29,760) \div 2 \dots\dots\dots 31,793 \text{ LB}$
 2. From figure B3-5 "Optimum Cruise Altitude" read final cruise-climb altitude based on Estimated Weight $\dots\dots\dots 35,800 \text{ FT}$
 3. From figure B7-1 read descent distance $\dots\dots\dots 68 \text{ NMi}$
 4. Compute cruise distance
 $(650 - 100 - 58 - 68) \dots\dots\dots 349 \text{ NMi}$
- B. Use figure B4-3 for cruise-climb performance

1. Estimate fuel used to cruise
 $349 \text{ NMi} \dots\dots\dots 3000 \text{ LB}$
2. Compute average gross weight:
 $33,825 - (3000 \div 2) \dots\dots\dots 32,325 \text{ LB}$
3. From figure B3-5 "Optimum Cruise Altitude" read the altitude for the average gross weight during cruise $\dots\dots\dots 35,500 \text{ FT}$
4. From figure B1-10 read Standard Day temperature at 35,500 FT pressure altitude $\dots\dots\dots -55^\circ \text{C}$
5. From figure B4-3 fuel used to cruise 349 NMi $\dots\dots\dots 2635 \text{ LB}$

C. Since the estimated fuel does not equal the computed fuel

1. Re-estimate average gross weight
 $33,825 - (2635 \div 2) \dots\dots\dots 32,507 \text{ LB}$
2. Re-read average cruise altitude from figure B3-5 $\dots\dots\dots 35,400 \text{ FT}$
3. Read temperature at 35,400 FT pressure altitude $\dots\dots\dots -55^\circ \text{C}$
4. From figure A4-3 fuel used to cruise 411 NMi $\dots\dots\dots 2635 \text{ LB}$
5. Mach number for cruise $\dots\dots\dots 0.886 \text{ M}$
6. Time to cruise $\dots\dots\dots 40.6 \text{ MIN}$
7. Final gross weight
 $(33,825 - 2640) \dots\dots\dots 31,190 \text{ LB}$
8. Fuel remaining $(4065 - 2635) \dots\dots\dots 1430 \text{ LB}$
9. From figure B4-3 "Optimum Cruise Altitude" read final cruise altitude $\dots\dots\dots 36,200 \text{ FT}$

Step 12. Maximum Range Descent

- A. From figure B7-1 read distance to descent $\dots\dots\dots 71 \text{ NMi}$

Note: Descent distance was estimated in Step 11A. Since the descent distance varies from the estimate by +3 NMi., recalculate step 11 to reflect the change in descent performance.

RECALCULATION OF STEP 11

1. Compute required cruise distance
(575 - 100 - 58 - 71) 346 NMi
2. Using the same method as described in step 11 yields the following performance for a cruise distance of 346 NMi from figure B4-3
 - a. Fuel used to cruise 2615 LB
 - b. Mach number for cruise 0.886 M
 - c. Time to cruise 40.4 MIN
 - d. Final gross weight
(33,825 - 2615) 31,210 LB
 - e. Fuel remaining
(4065 - 2615) 1450 LB
 - f. From figure B3-5 "Optimum Cruise Altitude" read final cruise altitude 36,300 FT
- B. Having adjusted the cruise segment continue the mission by computing the Maximum Range Descent

1. From figure B7-1 read distance to descend 71 NMi

Note

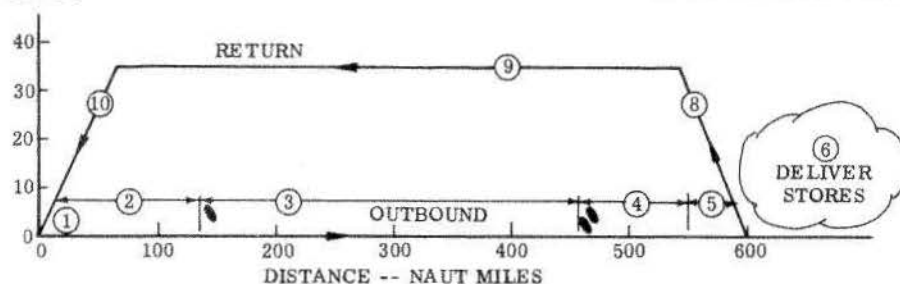
Since the descent distance of step 12B is the same as that used in step 12A, the mission can be continued.

2. From figure B7-1
Fuel used in descent 215 LB
3. Time elapsed in descent 11 MIN
4. Final gross weight
(31,210 - 215) 30,995 LB
5. Fuel remaining
(1450 - 215) 1235 LB

Summary: Total Mission Performance

1. Radius of Action 575 NMi
2. Time 2 HR +17 MIN
3. Fuel remaining for
landing reserve 1235 LB

Lo-Lo-Hi Mission (Sample Problem II)

PRESS
ALT
1000 FTInitial Config: Clean + 650 Gal. Tank (centerline)
+ (2) 450 Gal Tanks + (2) M-117 750 Lb BombsTake-off Gross Wt. = 53,242 Lb
Total Fuel = 3100 Gal = 20,150 Lb
Water for T.O. = 300 LB650 Gal Tank 347 Lb.
450 Gal Tanks 658 Lb.
Bombs & Pylons 1862 Lb. } Stores
Jettisoned

Step	Operation	Config Drag Index	Leg Fuel Used	Sum Fuel Used	Fuel Re- maining	Final Gross Weight	Alt. At End of Step	Leg Time	Sum Time	Leg Dist.	Sum Dist.
			LB.	LB.	LB.	LB	FT.	MIN	HR:MIN	N MI	N MI
	Initial Condition			0	20150	53242			0		0
1	Taxi, Take-Off and Accelerate to Cruise Speed*		1500	1500	18650	51442	S. L.	1	0:01	0	0
2	Outbound Cruise (Use Centerline Tank) Jettison Centerline Tank	74	2725	4225	15925	48717 48370	S. L.	20	0:21	136	136
3	Outbound Cruise (Use Wing Tanks) Jettison Wing Tanks	60	5850	10075	10075	42520 41862	S. L.	47	1:08	319	455
4	Outbound Cruise	26	1590	11665	8485	40272	S. L.	14	1:22	95	550
5	Dash at S. L. at 0.9 Mach	26	1210	12875	7275	39062	S. L.	5	1:27	50	600
6	Lay Down Delivery of Bombs	26	280	13155	6995	36920	S. L.	1	1:28		
7**											
8	Military Thrust Climb to 35,000 Ft.	0	1160	14315	5835	35760	35000	7	1:35	57	657
9	Return Cruise	0	3850	18165	1985	31910	35000	59	2:34	477	1134
10	Max. Range Descent to S. L.	0	200	18365	1785	31710	S. L.	11	2:45	66	1200

*Reduce Weight 300 lb. for water.

**Step 7 of Mission Plan is: Summary of Performance at Target.

Figure B10-2

SAMPLE PROBLEM II: LO-LO-HI MISSION PLAN**Mission Rules:**

A combat mission is to be flown at long range cruise speeds, at tree top level to the target, returning at 35,000 feet, carrying drop tanks and two externally mounted M-117 750 pound bombs. Within 50 nautical miles of target a dash-in is to be performed at 0.9 Mach and the bombs released in a lay-down delivery. A minimum 1000 pound landing fuel reserve is required. The drop tanks are to be jettisoned when empty. Prepare a flight plan for a target 600 nautical miles from air base.

Weather Conditions:

An average 10°C colder than Standard Day with prevailing tailwinds of 20 knots.

Take-off Configuration: [947] N/C/W

Clean + 650 gal tank (centerline) + (2) 450 gal tanks (inboard) + (2) M-117 750 lb bombs (outboard).

Weights: Figure B1-5

Clean aircraft with full B/B tanks (10,075 lb fuel)	40,000 LB
Wing Tanks	658 LB
External fuel (650 gal + 900 gal = 4225 lb +5850 lb)	10,075 LB
(2) M117 750 lb bombs (799 x 2) .	1598 LB
(2) Universal Outboard Pylons (132 x 2)	264 LB
Water for Take-off	300 LB
Take-off gross weight	53,242 LB
Total fuel on board (10,075 + 10,075)	20,150 LB

Computation:**Step 1. Take-off.**

Assume that 1500 lb of fuel, one minute and 300 lb of water are used for take-off and acceleration to cruise speed.

Gross Weight After Take-Off
(53,242 - 1500 - 300) 51,442 LB

Time elapsed 1.0 MIN

Fuel Remaining (20,150 - 1500) ... 18,650 LB

Step 2. Outboard Cruise (first leg)**A. From figure B1-5 determine the Initial Configuration Drag Index.**

(1) 650 gal tank (centerline)	14
(2) 450 gal tank (inboard)	28
(2) M-117 750 lb bombs (outboard) in presence of inb'd tanks	32
Initial Configuration Drag Index	74

Note

Configuration Drag Index changes whenever external tanks, bombs and/or pylons are jettisoned.

B. Use figure B4-2 for Cruise Performance.

1. Cruise with fuel remaining in centerline tank (4225 - 1500) 2725 LB
2. Compute Average Gross Weight:
51,442 - (2725 ÷ 2) 50,079 LB
3. Read Standard Day Temperature at Sea Level Pressure Altitude from Standard Atmosphere Table (figure B1-10) +15°C
4. Compute ambient Temperature (+15° - 10°) = +5°C
5. From figure B4-2 read
 - a. Cruise Distance (including effect of tailwind) ... 136 NMi
 - b. Mach number for cruise 0.615 M
 - c. Time to cruise 19.5 MIN
6. Final Gross Weight
(51,442 - 2725) 48,717 LB

7. Fuel Remaining
(18,650 - 2725) 15,925 LB

C. Jettison Centerline Tank

1. Final Gross Weight
(48,717 - 347) 48,370 LB

2. New Configuration Drag Index
(figure B1-5)

(2) 450 gal tanks (inboard) 28

(2) M-117 750 lb bombs (outboard)
in presence of inboard tanks 32

Configuration Drag Index 60

Step 3. Outbound Cruise (second leg)

A. Cruise with Wing Tank Fuel

1. Fuel Used to cruise 5850 LB

2. Compute Average Gross Weight:
 $48,370 - (5850 \div 2)$ 45,445 LB

3. Ambient Temperature
(computed in Step 2-B-4) +5°C

4. From figure B4-2 read:

a. Cruise distance 319 NMi

b. Mach number for cruise 0.595 M

c. Time to cruise 46.8 MIN

5. Final Gross Weight
(48,370 - 5850) 42,520 LB

6. Fuel Remaining (15,925 - 5850) 10,075 LB

B. Jettison Wing Tanks

1. Final Gross Weight (42,520 - 658) 41,862 LB

2. New Configuration Drag Index
(figure B1-5)

(2) M-117 750 lb bombs (outboard) not in presence of inboard tanks 26

Step 4. Outboard Cruise (third leg)

A. Flight plan requires 600 nautical mile radius of which 50 nautical miles (outbound) is dash at 0.9 Mach. Thus far, 455 nautical miles have been computed. The remaining outbound cruise is therefore
(600 - 455 - 50) 95 NMi

1. Estimate fuel required 1000 LB

2. Estimate Average Gross Weight
 $41,862 - (1000 \div 2)$ 41,362 LB

3. Ambient Temperature
(computed in Step 2-B-4) +5°C

4. From figure B4-2 for a 95 NMi cruise read: Fuel Used 1590 LB

B. Since the estimated fuel does not equal the computed fuel

1. Re-estimate Average Gross Weight
 $41,862 - (1590 \div 2)$ 41,067 LB

2. Ambient Temperature +5°C

3. From figure B4-2 for a 95 NMi cruise read

a. Fuel used 1590 LB

b. Mach number for cruise 0.59 M

c. Time to cruise 13.9 MIN

4. Final Gross Weight (41,862 - 1590) 40,272 LB

5. Fuel Remaining (10,075 - 1590) 8485 LB

Step 5. Dash at Sea Level at 0.9 Mach number for 50 Nautical Miles

A. Since figure B4-4 is entered at average gross weight, estimate the fuel used for 50 nautical mile run-in.

1. Estimate dash fuel 2000 LB

2. Estimate Average Gross Weight
 $40,272 - (2000 \div 2)$ 39,272 LB

3. Ambient Temperature
(see Step 2-B-4) +5° C

4. From figure B4-4 read True
Airspeed at 0.9 Mach number
at 5° C 585 Knots

5. From figure B4-4 read:
Fuel Flow 14,550 LB/HR

6. Compute ground speed = True
Airspeed + Tailwind (585 + 20) 605 Knots

7. Compute time required to dash
50 NMI: Distance ÷ Ground Speed =
(50 ÷ 605) = 0.083 HR

8. Compute fuel required = fuel flow x
time (14,550 x 0.083) 1210 LB

B. Since the estimated fuel does not equal the com-
puted fuel

1. Re-estimate Average Gross Weight:
40,272 - (1210 ÷ 2) 39,667 LB

2. Ambient Temperature +5° C

3. From figure B4-4 True Airspeed 585 Knots

4. From figure B4-4 fuel flow ... 14,550 LB/HR

5. Since True Airspeed and Fuel Flow
have not changed, Steps 5A6 thru
8 do not have to be redone.

6. Time required for dash 0.083 hr. x
 $\frac{60 \text{ min}}{\text{hr}}$ 5.0 MIN

7. Final Gross Weight (40,272 - 1210) 39,062 LB

8. Fuel Remaining (8485 - 1210) 7275 LB

Step 6. Deliver Bombs

A. Assume 280 lb of fuel and one minute of time
for a lay-down delivery.

1. Final Gross Weight
(39,062 - 280 - 1862*) ... 36,920 LB

2. Time Elapsed 1 MIN

3. Fuel Remaining (7275 - 280) 6995

*Weight of bombs and pylons.

B. New Configuration Drag Index from figure B1-5
for clean aircraft = 0.

Step 7. Summary of Performance at Target

1. Aircraft Gross Weight 36,920 LB

2. Fuel Remaining 6995 LB

3. Distance Covered 600 NMI

4. Time Elapsed 1 HR 28 MIN

5. Configuration Drag Index ... 0

Note

For return, assume no change in
weather conditions; therefore, the
20 knot wind is now a headwind.

Step 8. Military Thrust Climb to 35,000 feet

A. From figure B3-4

1. Fuel Used 1160 LB

2. Distance Covered 57 NMI

3. Time Elapsed 7.0 MIN

Note

Climb charts include effect of average
Ambient Temperature. Effect of wind
can be considered negligible.

B. 1. Final Gross Weight (36,920 - 1160) 35,760 LB

2. Fuel Remaining (6995 - 1160) .. 5835 LB

Step 9. Return Cruise

A. Determine Return Cruise Distance. Since re-
turn distance must equal 680 nautical miles
including climb, cruise and descent, estimate
a descent distance

1. Estimate a weight at start of descent as:

(Weight at end of climb + Empty Weight)
÷ 2 (35,760 + 29,925) ÷ 2 = 32,843 LB

2. From figure B7-1,
distance to descend 66 NMI

3. Cruise distance required
(600 - 57 - 66) 477 NMi

B. For a cruise of 477 NMi at 35,000 feet

1. Estimate fuel required 3000 LB
2. Estimate Average Gross Weight
35,760 - (3000 ÷ 2) 34,260 LB
3. Read Standard Day Temperature at 35,000
feet pressure altitude from Standard Atmos-
phere Table (figure B1-10) -54.34°C
4. Compute Ambient Temperature
(-54 - 10°) -64°C
5. From figure B4-2 read fuel used to
cruise 477 miles 3835 LB

C. Since the estimated fuel does not equal the
computed fuel

1. Re-estimate average gross weight:
35,760 - (3835 ÷ 2) 33,842 LB
2. Ambient Temperature
(same as 9-B-4) -64°C
3. From figure B4-2 for a 477 NMi
cruise read:
 - a. Fuel used 3850 LB

- b. Mach number for cruise 0.892 M

- c. Time to cruise 58.9 MIN

4. Final Gross Weight (35,760 -
3850) 31,910 LB

5. Fuel Remaining (5585 - 3850) ... 1985 LB

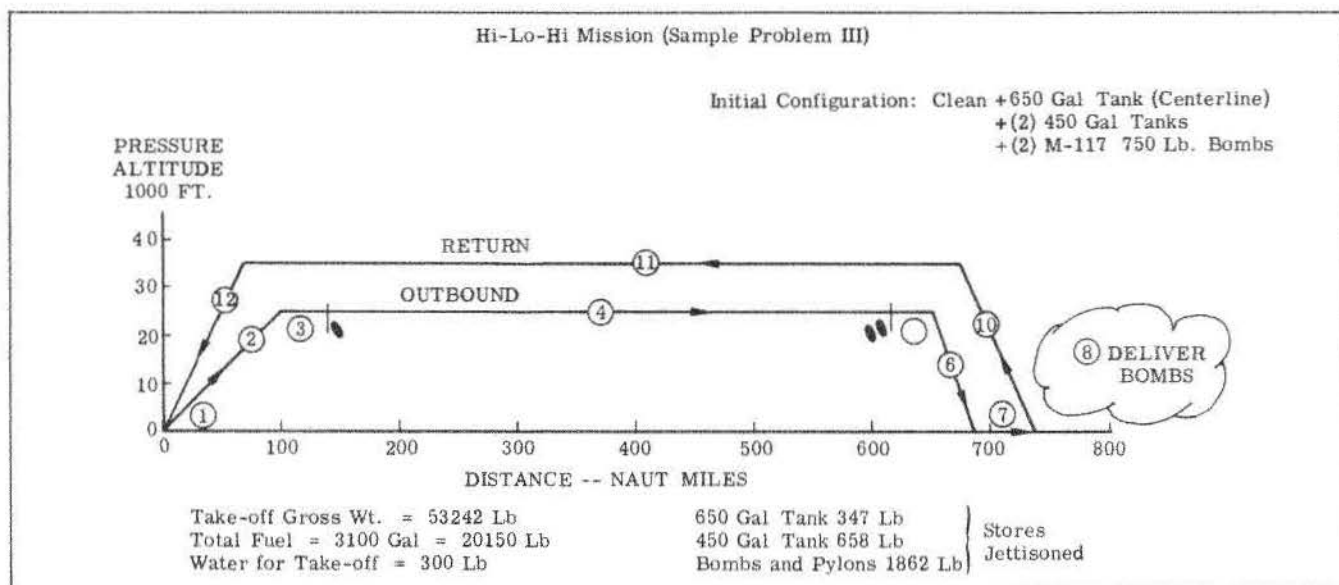
Step 10. Maximum Range Descent

A. From figure B7-1

1. Distance to descend 66 NMi
(Since distance to descend (66 NMi)
is the same as estimated in Step 9A,
Mission can be continued)
2. Fuel used in descent 200 LB
3. Time elapsed in descent 10.6 MIN
4. Final Gross Weight (31,910 - 200) . 31,710 LB
5. Fuel Remaining (1985 - 200) 1785 LB

Summary: Total Mission Performance

1. Radius of Action .. 600 NMi
2. Total Mission Time 3 HRS 45 MIN
3. Fuel Remaining (or Reserve) 1785 LB



Step	Operation	Config Drag Index	Leg Fuel Used	Sum Fuel Used	Fuel Remaining	Final Gross Weight	Alt. at End of Step	Leg Time	Sum Time	Leg Dist.	Sum Dist.
			LB.	LB.	LB.	LB.	FT.	MIN	HR:MIN	NMI	NMI
	Initial Configuration			0	20150	53242			0		0
1	Taxi, Take-Off and Accelerate to climb speed*		1500	1500	18650	51442	S. L.	1	0:01	-	0
2	Military Thrust Climb to Initial Cruise Altitude	74	2180	3680	16470	49262	25000	13	0:14	99	99
3	Outbound Cruise (Use Centerline Tank) Jettison Centerline Tank	74	545	4225	15925	48717	25000	5	0:19	39	138
4	Outbound Cruise (Use Wing Tanks) Jettison Wing Tanks	60	5850	10075	10075	42520	25000	54	1:13	477	615
5	Outbound Cruise	26	375	10450	9700	41487	25000	4	1:17	38	653
6	Combat Descent to S. L.	26	90	10540	9610	41397	25000	4	1:21	33	686
7	Dash at S. L. at 0.90 Mach	26	1210	11750	8400	40187	S. L.	5	1:26	50	736
8	Lay Down Delivery of Bombs	26	280	12030	8120	38045	S. L.	1	1:27	-	
9**											
10	Military Thrust Climb to 35000 Ft.	0	1220	13250	6900	36825	35000	7	1:34	60	796
11	Return Cruise	0	4915	18165	1985	31910	35000	75	2:49	610	1406
12	Maximum Range Descent to S. L.	0	200	18365	1785	31710	S. L.	11	3:00	66	1472

* Reduce Weight 300 lb. for water

** Step 9 of Mission Plan is: Summary of Performance at Target

Figure B10-3

SAMPLE PROBLEM III: HI-LO-HI MISSION PLAN

- A. Estimate Radius of Action based on Sample Problem II. Sample Problem II was calculated as a Lo-Lo-Hi Mission requiring 600 NMi radius of action. To determine the increase in radius of action if the outbound cruise was accomplished at high constant altitude proceed as follows:

Step 1. Use: Rule of Thumb Number II
1.5 to 2 NMi range (high altitude)
equals one NMi range (low altitude).

Step 2.

- a. Outbound Cruise
600 - 50 = 550 cruise at S.L.
550 x 1.75 = 1130 cruise at high altitude
- b. 1103 cruise + 50 dash = 1153 NMi out-
bound range
- c. Return range (from Sample Problem II)
= 600 NMi
- d. Total Range: 1013 + 600 = 1613 NMi
- e. Estimated Radius = 807 NMi

Note

The 807 NMi Radius of Action is an Estimated Capability. A detailed flight plan must be computed to determine the exact radius capability as follows:

B. Check Radius of Action Estimate

Step 1. Take-off: Same as Sample Problem II

Final Gross Weight	51,442 LB
Fuel Remaining	18,650 LB
Configuration Drag Index	74

Step 2. Military Thrust Climb to Altitude

- A. From figure B3-4 read fuel and distance to climb from S. L. to Optimum Cruise altitude

1. Fuel used 2180 LB
2. Distance covered 99 NMi
3. Final Gross Weight (51,442 - 2180) 49,262 LB
4. Fuel remaining (18,650 - 2180) . . 16,470 LB
5. From figure B3-5 "Optimum
Cruise Altitude," read
altitude at end of climb 25,000 FT

Note

Since this mission is to be accomplished at constant altitude, level-off and cruise at altitude read in step 2.5 (25,000 FT).

Step 3. Outbound Cruise (First leg)

A. Use figure B4-2 for Cruise Performance

1. Cruise with fuel remaining in centerline
tank (4225 - 1500 - 2180) 545 LB
2. Compute Average Gross Weight
49,262 - (545 ÷ 2) 48,989 LB
3. Read Standard Day temperature at 25,000
FT pressure altitude from Standard Atmos-
phere Table (figure B1-10) -34.53°C
4. Compute Ambient Temperature
(-34.53° - 10°) = -45°C
5. From figure B4-2 read

- a. Cruise distance 39 NMi
- b. Mach number for cruise 0.866 M
- c. Time to cruise 4.5 MIN

6. Final Gross Weight
(49,262 - 545) 48,717 LB
7. Fuel Remaining (16,470 - 545) . . 15,925 LB

B. Jettison Centerline Tank

1. Final Gross Weight (48,717 - 347) . 48,370 LB

2. New Configuration Drag Index figure B1-5

(2) 450 gal tanks (inboard) . . .	28
(2) M-117 750 lb bombs	32
(outb'd) in presence of inboard tanks	
Configuration Drag Index =	60

Step 4. Outboard Cruise (Second leg)

- A. From figure B3-5 read optimum cruise altitude 25,700 FT

Note

Since optimum altitude is below 30,000 ft, continue cruising at 25,000 ft.

- B. Use figure B4-2 for Cruise Performance

1. Cruise with wing tank fuel	5850 LB
2. Compute Average Gross Weight 48,370 - (5850 ÷ 2)	45445 LB
3. Ambient Temperature (See step 3A4)	-45° C
4. From figure B4-2 read	
a. Cruise distance	477NMI
b. Mach number for cruise	0.863 M
c. Time to cruise	54.0 MIN
5. Final gross weight (48,370 - 5850)	42,520 LB
6. Fuel remaining (15,925 - 5850)	10,075 LB

- C. Jettison Wing Tanks

1. Final gross weight (42,520 - 658)	41,862 LB
2. New Configuration Drag Index (figure B1-5)	
(2) M-117 750 lb bombs (outb'd) not in presence of inboard tanks	26

Step 5. Outbound Cruise (Third leg)

- A. From figure B3-5 read "Optimum Cruise Altitude" 29,600 FT

Note

Since Optimum Cruise Altitude is below 30,000 ft, continue cruising at 25,000 ft.

- B. Determine remainder of cruise distance.

Since Estimated Radius of Action is 807 NMI, of which 615 NMI (99 + 39 + 477) has already been computed, approximately 192 NMI remain to reach the target. This 192 NMI will consist of cruise, descent and 50 NMI of dash. Since the radius is only approximate, the exact length of this leg is not significant, but would be approximately 100 NMI

- C. For a cruise of 100 NMI at 25,000 ft

1. Estimate fuel required	1000 LB
2. Estimate Average Gross Weight 41,862 - (1000 ÷ 2)	41,362 LB
3. Ambient Temperature (See step 4B3)	-45° C
4. From figure B4-2 read:	
Fuel used to cruise 100 NMI . . .	1000 LB

Note

Since the estimated fuel yielded the exact distance required (100 NMI) step 5C4 can be considered final.

5. From figure B4-2 read:

a. Mach number for cruise	0.868 M
b. Time to cruise	11.1 MIN
6. Final gross weight (41,862 - 1000)	40,862 LB
7. Fuel remaining (10,075 - 1000)	9075 LB

Step 6. Combat Descent to Sea Level

Note

(0.9 Mach or 400 KCAS whichever is less)
from figure B7-2.

1. Distance to descent	33 NMi
2. Fuel used in descent	90 LB
3. Time elapsed in descent	4.3 MIN
4. Final gross weight (40,862 - 90)	40,772 LB
5. Fuel remaining (9075 - 90)	8985 LB

Step 7. Dash at Sea Level at 0.9 Mach number for 50 nautical miles.

A. Since a small difference in average gross weight will not significantly change the fuel flow at 0.9 Mach at Sea Level, use data computed in step 5 of Sample Problem II.

1. Fuel used	1210 LB
2. Final gross weight (40,772 - 1210)	39,562 LB
3. Fuel remaining (8985 - 1210)	7775 LB

Step 8. Deliver Bombs

A. Same as step 6 of Sample II

1. Fuel used	280 LB
2. Final gross weight (39,562 - 280 - 1862*)	37,420 LB
3. Fuel remaining (7775 - 280)	7495 LB

* Weight of bombs and pylons.

B. New Configuration Drag Index = ... 0

Step 9. Summary of Performance at Target

1. Aircraft Gross Weight	37,420 LB
2. Fuel remaining	7495 LB
3. Distance covered	798 NMi

For return, assume no change in weather conditions; therefore, the 20 knot wind is now a headwind.

Step 10. Military Thrust Climb to 35,000 FT.

A. From figure B3-4

1. Fuel used	1200 LB
2. Distance covered	58 NMi

Note

Climb Charts include effect of average ambient temperature. Effect of wind can be considered negligible.

B. 1. Final gross weight (37,420 - 1200)	36,220 LB
2. Fuel remaining (7495 - 1200)	6295 LB

Step 11. Return Cruise

A. 1. Allowing the same amount of fuel for descent and landing reserve as in Sample Problem II, fuel available for final cruise leg is (6295 - 200 - 1785)	4310 LB
--	---------

2. Compute Average Gross Weight $36,220 - (4310 \div 2)$	34,065 LB
---	-----------

3. From figure B1-10, Standard Day Temperature at 35,000 FT pressure altitude	-54.34° C
---	-----------

4. Compute Ambient Temperature (-54 -10)	-64° C
--	--------

5. From figure B4-2 cruise distance	534 NMi
---	---------

6. Final gross weight (36,220 - 4310)	31,910 LB
--	-----------

7. Fuel remaining (6295 - 4310)	1985 LB
--	---------

Step 12. Maximum Range Descent to Sea Level

(534 NMi ÷ 4310 LB
of fuel)

0.1239 NMi/LB

A. From figure B7-1

1. Distance to descend 66 NMi

2. Fuel used to descend 200 LB

3. Final gross weight
(31,910 - 200) 31,710 LB

4. Fuel remaining
(1985 - 200) 1785 LB

B. Total return distance
(58 + 534 + 66) 658 NMi

4. Fuel to be transferred
from outbound to return
leg = incremental range
÷ (outbound NMi/LB
+ return NMi/LB) or
 $140 \div (0.100 + 0.1239)$
 $= 140 \div 0.2239 =$ 625 LB

B. Change Outbound Cruise by

1. $-625 \times 0.100 =$ -63 NMi

2. Revised return range
(798 - 63) 735 NMi

Step 13. Balance Mission

A.1. Since outbound range is
798 NMi and return is
658, mission is out of
balance by (798 - 658) 140 NMi

2. Compute NMi/LB for
last outbound cruise leg
(100 NMi ÷ 1000 LB
of fuel) 0.100 NMi/LB

3. Compute NMi/LB for
return cruise leg

C. Change Return Cruise by

1. $+625 \times 0.1239 =$ +77 NMi

2. Revised return range
(658 + 77) 735 NMi

D. Revised Estimated
Radius of Action = 735 NMi

Step 14. If a precise mission plan is required, re-
peat steps 1 thru 12, adjusting cruise fuel
as indicated in step 13. The resulting
mission plan is shown as figure B10-3.

SAMPLE PROBLEM IV: LO-HI MISSION PLAN

A combat radius to be flown at long range cruise speeds, at tree-top level to the target, returning at 35,000 feet, carrying drop tanks and an internal store. Drop tanks are to be jettisoned when empty and the store released in a lay-down delivery. Prepare a flight plan to determine the maximum radius capability under these rules, retaining a 2000 pound landing fuel reserve.

Weather Conditions:

Standard Day, no wind.

Take-Off Configuration: [947] N/C/W

Clean + (2) 450 gal tanks + internal store

Weights: Figure B1-5

Clean Aircraft without B/B tank (7540 lb of fuel)	37,300 LB
(2) 450 gal tanks	658 LB
External Fuel (900 gal tanks)	5850 LB
Internal Store	2000 LB
Water for Take-Off	300 LB
Take-Off Gross Weight	46,108 LB
Total Fuel on board	13,390 LB

Note

To determine a radius of action for a set of given conditions proceed according to the following general outline:

“A” Estimate radius of action by using “Rules of Thumb”

“B” Compute a detailed flight plan for the estimated radius.

“C” Adjust “B” to obtain maximum radius of action.

“A” Estimate Radius of Action from Rules of Thumb I Lo-Hi Mission

Normal Internal Fuel 155 NMi

Wing Tanks	210 NMi
Estimated R/A	365 NMi

“B” Prepare Flight Plan for Estimated Radius

Step 1. Take-Off

Assume that 1500 pounds of fuel, one minute and 300 pounds of water are used for take-off and acceleration to cruise speed:

Gross Weight After Take-Off (46,108 - 1500 - 300)	44,308 LB
Time Elapsed	1 MIN
Fuel Remaining (13,390 - 1500)	11,890 LB

Step 2. Outbound Cruise - (first leg)

A. From figure B1-5 determine the initial configuration drag index	
(2) 450 gal tanks	28

Note

Configuration Drag Index changes whenever external tanks, bombs and/or pylons are jettisoned.

B. Use figure B4-2 for Cruise Performance	
1. Cruise with fuel remaining in wing tanks (5850 - 1500)	4350 LB
2. Compute Average Gross Weight 44,308 - (4350 ÷ 2)	42,133 LB
3. From figure B1-10 Standard Day Temperature at Sea Level pressure altitude	+15°C
4. From figure B4-2	
Mach number for cruise	0.595 M
Time to cruise	30 MIN
Cruise distance	197 NMi
5. Final Gross Weight (44,308 - 4350)	39,958 LB

6. Fuel Remaining (11,890 - 4350) . . . 7540 LB

C. Jettison Wing Tanks

1. Final Gross Weight
(39958 - 658) 39,300 LB

2. New Configuration Drag Index
(from figure B1-5)
for the Clean Aircraft 0

Step 3. Outbound Cruise (Second Leg)

A. Flight Plan requires an estimated 365 nautical mile radius. Thus far, 197 NMi have been computed. The remaining outbound cruise is therefore (365 - 197) 168 NMi

1. Estimate fuel used 3000 LB

2. Estimate average gross weight
 $39,300 - (3000 \div 2)$ 37,800 LB

3. Ambient Temperature
(See step 2-B-3) +15°C

4. From figure B4-2 read fuel used
for 168 NMi. 2705 LB

B. Since the estimated fuel does not equal the computed fuel

1. Re-estimate Average Gross Weight
 $39,300 - (2705 \div 2)$ 37,947 LB

2. Ambient Temperature
(Same as step 3A-3) +15°C

3. From figure B4-2 for a 168 NMi cruise read

a. Fuel used 2705 LB

b. Mach number for cruise 0.589 M

c. Time to cruise 26 MIN

4. Final Gross Weight
(39,300 - 2705) 36,595 LB

5. Fuel Remaining (7540 - 2705) . . . 4835 LB

Step 4. Deliver Store

Assume 280 lb of fuel and 1 min of time for a lay-down delivery.

1. Final Gross Weight
(36,595 - 280 - 2000*) 34,315 LB

2. Fuel Remaining (4835 - 280) 4555 LB

3. Time Elapsed 1 MIN

*Weight of Store

Step 5. Summary at Target

1. Fuel Remaining 4555 LB

2. Distance Covered 365 NMi

3. Time Elapsed 58 MIN

4. Aircraft Gross Weight 34,315 LB

5. Configuration Drag Index 0

Step 6. Military Thrust Climb to Cruise Altitude

A. From figure B3-4

1. Fuel Used 1125 LB

2. Distance Covered 58 NMi

3. Time Elapsed 7.2 MIN

4. Final Gross Weight
(34,315 - 1125) 33,190 LB

5. Fuel Remaining (4555 - 1125) . . . 3430 LB

Step 7. Return Cruise

A. Determine return cruise distance. Since return distance must equal 365 NMi including climb, cruise and descent, estimate the descent distance.

1. Estimate weight at start of descent as:
(Weight at end of climb + Empty Weight + Fuel Reserve) $\div$ 2 (33,190 + 29,760 + 1200 $\div$ 2) 3207 LB

2. From figure B7-1 read distance to descend from 35,000 ft 67 NMi

3. Compute Cruise Distance required
(365 - 58 - 67) 240 NMi

B. Estimate fuel used to cruise 240 NMi.

1. Estimate fuel used 2000 LB

- 2. Estimate Average Gross Weight
33,900 - (2000 ÷ 2) 32,190 LB
- 3. From figure B1-10 Standard Day
Temperature at 35,000 ft
pressure altitude -54.3°C
- 4. From figure B4-2 read fuel used
to cruise 240 NMi 1725 LB
- C. Since estimated fuel does not equal computed
fuel

- 1. Re-estimate Average Gross Weight
33,190 - (1725 ÷ 2) 32,327 LB
- 2. Ambient Temperature
(Same as step 7-B-3) -54.3°C
- 3. From figure B4-2 read
 - a. Fuel used 1725 LB
 - b. Mach number for cruise 28 M
 - c. Time to cruise 28 MIN
- 4. Final Gross Weight
(33,190 - 1725) 31,465 LB
- 5. Fuel Remaining (3430 - 1725) .. 1705 LB

Step 8. Maximum Range Descent

- A. From figure B7-1 read
 - 1. Distance to descend 67 NMi

Note

Descent distance was estimated in step 7A. Since the estimated distance equals the distance read in step 8, the mission can be continued.

- 2. Fuel used to descend 208 LB
- 3. Time to descend 10.9 MIN
- 4. Final Gross Weight (31,465 - 208) . 31,257 LB

- 5. Fuel Remaining (1705 - 208) 1497 LB

Note

Initial Mission Rules stated that reserve fuel should equal 1200 lb. The above flight plan accomplishes the estimated radius of 365 NMi with a fuel reserve of 1497 lb. Therefore, adjust radius capability for the additional 297 lb of usable fuel.

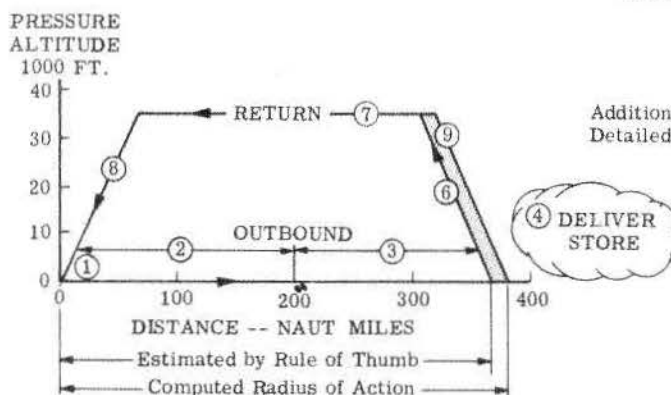
Step 9. Correct estimated Radius of Action as follows:

- A. To distribute the additional 297 lb of fuel
 - 1. Compute return cruise NMi/LB:
(dist ÷ fuel) = 240 ÷ 1725
(from step 7) = 0.1391 NMi/LB
 - 2. Compute outbound cruise NMi/LB
(dist ÷ fuel) = 168 ÷ 2705
(from step 3) = 0.0627 NMi/LB
 - 3. Compute additional distance if all
additional fuel were used for return
(fuel x NMi/LB)
297 x 0.1391 = 41 NMi
 - 4. Compute the additional outbound
fuel needed to balance radius
Incremental range ÷ (outbound NMi/LB +
return NMi/LB or 41 ÷ (0.621 + 0.391) =
41 ÷ 0.2012 = 204 LB
 - 5. The additional 297 lb of fuel therefore,
should be distributed as:
204 lb (outbound cruise) x
0.0621 = 13 NMi
0.150 (1065 - 737) = 13 NMi
 - 6. Therefore, the maximum radius of
action is 365 NMi + 13 NMi = ... 378 NMi

Note

If a detailed flight plan is required, re-
turn to step 3 and adjust cruise fuel
as indicated above, and recompute the
mission from that point.

Lo-Hi Mission (Sample Problem IV)

Initial Configuration: Clean + (2) 450 Gal Tanks
+ Internal Store

Take-off Gross Wt. = 46108 Lb
 Total Fuel = 2060 Gal = 13390 Lb
 Water for Take-off = 300 Lb

450 Gal Tanks = 658 Lb } Stores
 Internal Store = 2000 Lb } Jettisoned

Step	Operation	Config Drag Index	Leg Fuel Used	Sum Fuel Used	Fuel Re- maining	Final Gross Weight	Alt. at End of Step	Leg Time	Sum Time	Leg Dist.	Sum Dist.
			LB.	LB.	LB.	LB.	FT.	MIN	HR:MIN	N MI	N MI
	Initial Configuration				13390	46108			0		0
1	Taxi, Take-Off and Accelerate to cruise speed*		1500	1500	11890	44308	S. L.	1	0:01	-	0
2	Cruise at Sea Level (Use Wing Tank Fuel) Jettison Wing Tanks	28	4350	5850	7540	39958	S. L.	30	0:31	197	197
						39300					
3	Cruise at Sea Level	0	2705	8555	4835	36595	S. L.	26	0:57	168	365
4	Lay Down Delivery of Store	0	280	8835	4555	34315	S. L.	1	0:58	-	
5**											
6	Military Thrust Climb to 35000 Ft.	0	1125	9960	3430	33190	35000	7	1:05	58	423
7	Cruise at 35000 Ft.	0	1725	11685	1705	31465	35000	28	1:33	240	663
8	Maximum Range Descent to S. L.	0	208	11893	1497	31257	S. L.	11	1:44	67	730
9	Compute: Additional Distance Capability to have 1200 Lb. of Fuel Remaining	297 Lb.	$\left\{ \begin{array}{l} 204 \times .0621 = 13 \text{ NMI} \\ 93 \times .1391 = 13 \text{ NMI} \end{array} \right\}$				See Detailed Sample IV				

* Reduce Weight 300 lb. for water

** Step 5 of Mission Plan is: Summary of Performance at Target

Figure B10-4

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